he Welding Engineer

NEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

olume XXV October, 1940 Number 10

The welding and cutting arts are at the threshold of another expansion. Demands in shipbuilding, aircraft, agricultural, automotive, arsenal and other basic production advances in these times give welding and cutting apparatus an important responsibility.

Since 1908 The Bastian-Blessing Company has pioneered and specialized in the design and manufacture of equipment for the control and use of high pressure industrial gases. Its aggressive engineering has scored many firsts in design and production. Its full line of Rego welding and cutting equipment has many distinctive and exclusive performance advantages.

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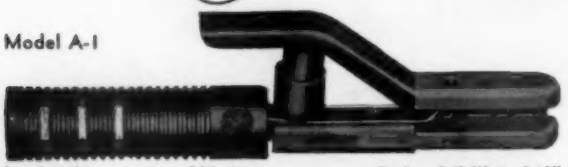
I am pleased to announce that these two objectives have been consummated as the result of an arrangement entered into with National Cylinder Gas Company which becomes effective at once. National will use the facilities of The Bastian-Blessing Company and engage in the production of an even more complete line of welding and cutting equipment under the Rego trade mark. The arrangement perpetuates the activities of the fine Rego Distributor organization, making Rego available not only through such Distributors but also through National district sales offices in all principal cities.

Ellsworth L. Mills

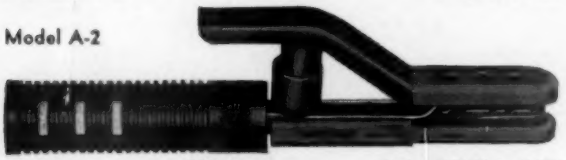
Industry Oks Jackson Holders

Model A-1



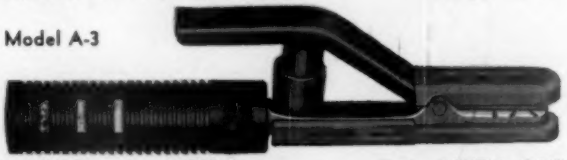
Insulated Stationary Jaws — 300 Amp. — Rods—1/16" to 1/4" — Weight 22 oz.

Model A-2



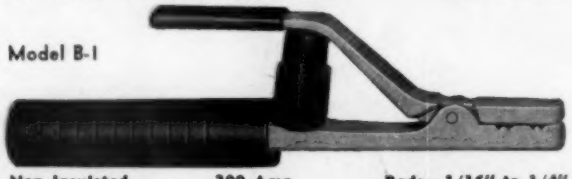
Insulated Replaceable Jaws of Mallory 3 Metal — 300 Amp. — Rods—1/16" to 1/4" — Weight 22 oz.

Model A-3



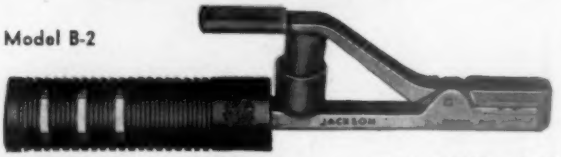
Insulated Replaceable Jaws of Mallory 3 Metal — 500 Amp. — Rods—1/16" to 3/8" — Weight 27 oz.

Model B-1



Non-Insulated Stationary Jaws — 300 Amp. — Rods—1/16" to 1/4" — Weight 18 oz.

Model B-2

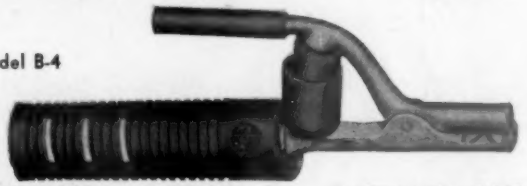


Non-Insulated Replaceable Jaws of Mallory 3 Metal — 300 Amp. — Rods—1/16" to 1/4" — Weight 19 oz.

Model B-3

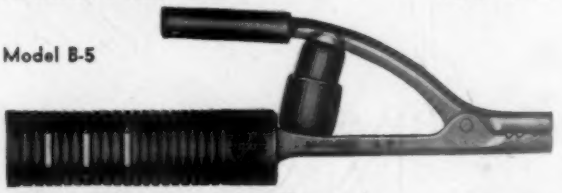
Non-Insulated Replaceable Jaws of Mallory 3 Metal — 500 Amp. — Rods—1/16" to 3/8" — Weight 24 oz.

Model B-4



Non-Insulated All Mallory 3 Metal — 200 Amp. — Rods—1/16" to 3/16" — Weight 15 oz.

Model B-5



(Same as B-4 except it is 1 1/4" longer.) Length—10 3/8" — Weight 16 oz.

Model F-3

Insulated Replaceable Jaws of Mallory 3 Metal — 300 Amp. — Rods—1/16" to 1/4" — Weight 22 oz.

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OCTOBER, 1940

The Welding Engineer

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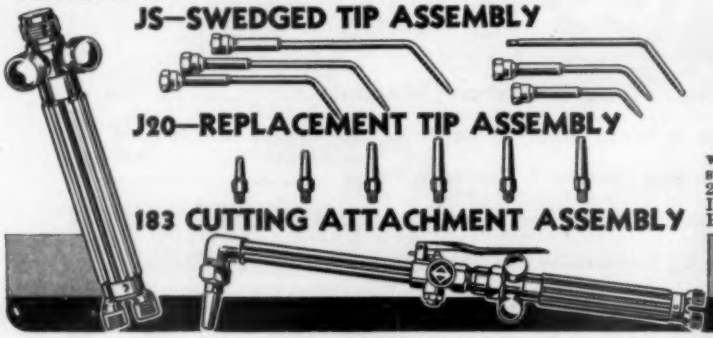

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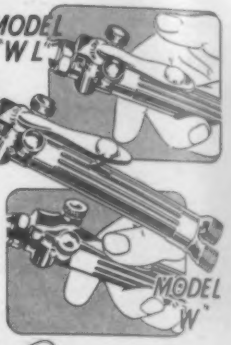

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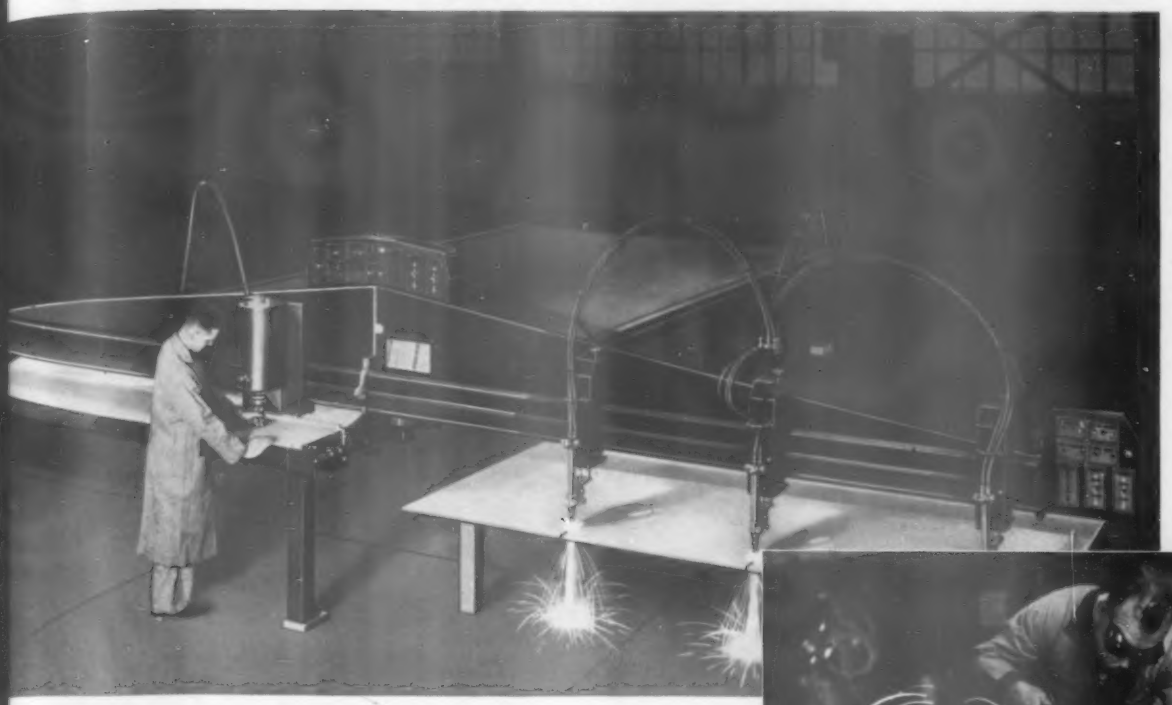

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Big event in itself is the union of these four trademarks for the first time in the three National Cylinder Gas Company booths, H-40, G-40, G-42. . . . At the National Metal Congress and Exposition, Cleveland, Ohio, October 21-25, 1940.

*FOR THE FIRST TIME Hollup Corporation will demonstrate its new Speed-Arc Welder . . . with the exclusive synchronous motor feature resulting in a much higher power factor. Also the year's outstanding achievements of Hollup's chemical, physical, research and welding laboratories will bring to you full understanding of improvements made in Sureweld Protected-Arc electrodes. Witness these eventful Hollup demonstrations [illegible]

We Invite You to Our Associated Preview at Cleveland's National Metal Congress and Exposition

•

October 21-25
1940

Under the association of these four trademarks — C.I.G., HOLLUP, REGO, and NATIONAL — carefully trained technicians will reveal dramatically in Booths G-40, G-42, H-40, newsworthy National achievements in the full range of welding and cutting arts.

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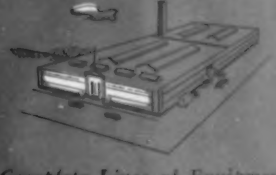

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What's Here?

RESEARCH

Fish-Eyes in a new light and a new exposition as to their causes. Author Duma in presenting his theory on the causes of fish-eyes in weld deposits (page 25) has arrived at the same conclusions that were obtained recently by Swedish investigators as well as a research staff of Illinois University.

» «

GENERAL

Before leaving to join his regiment, E. Dacre Lacy recorded for the readers of The Welding Engineer some English thoughts on Welded Warships (page 55.) Included in his discussion are some important facts on welded warship construction together with pertinent data on some of the German packet battleships which have played an important part in World War II.

» «

MAINTENANCE

Equipment maintenance is always a problem, but D. B. Rice, in his article on page 33, presents some pointers to make it easier so far as steel mills are concerned. He uses hard-facing materials for the reduction of maintenance cost and the increasing of equipment life.

ALLOYS

The third and concluding article of the series on High Nickel Alloys on page 51 discusses surface preparation and preheating as well as electrode manipulation and oxy-acetylene jigs and clamps.

» «

GENERAL

James T. Barton, a newcomer to the pages of The Welding Engineer, brings a timely review on flame-cutting (page 30) and how it will be an important factor in our National Defense program.

» «

NEW FEATURES

Of the new features—there are three in this issue that will appear regularly each month in succeeding issues—this page is the first. Do you like to have the Editor give you his slant on The Welding Engineer's editorial content? The second new feature on page 47 is the first of a series of Engineering Data Sheets. In it is given some interesting dope on the amount of metal in a fillet weld — just something most of us had never taken time to figure out. These sheets will contain just the information you want so you had better save them. Feature three is found on page 50—*THE TECHNICAL SLANT* is a page of book reviews designed to bring to the readers of The Welding Engineer reviews of new books that are believed to be of interest to the welding industry.

What's Coming?

WELDING THIN STAINLESS SHEETS BY ATOMIC HYDROGEN

POSITIONERS FOR ECONOMICAL FABRICATION

A REVIEW OF THE HAPPENINGS AT CLEVELAND

SEE THE AIRCO No. 10 PLANOGRAPH IN *Action*

at the
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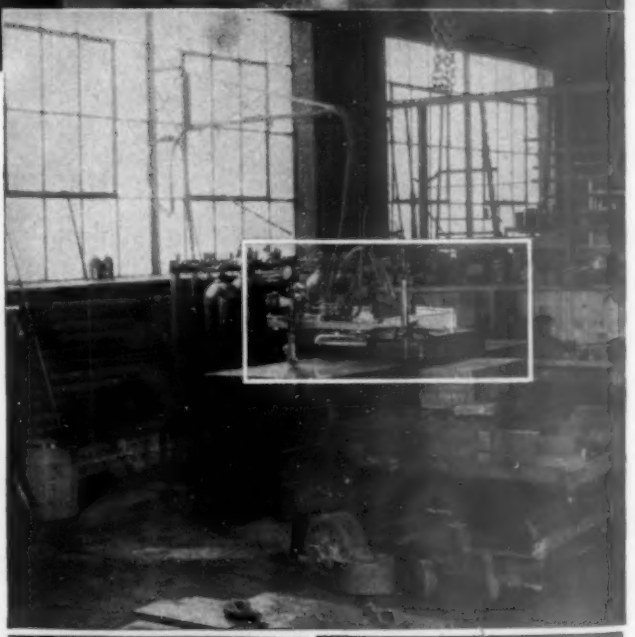
CLEVELAND PUBLIC AUDITORIUM
Oct. 21-25



The No. 10 Planograph, one of an extensive line of gas cutting machines being widely used in America's National Defense program, will be the feature of Airco's display of the Metal Show. Already gaining wide acclaim because of its outstanding performance, this Planograph cuts straight lines, rectangles, circles, irregular shapes, etc. quickly and economically from ferrous metal of any thickness within the present practical limits of the cutting torch. A minimum of floor space is needed as the illustration to the right shows so well.

This is your opportunity to see the No. 10 Planograph in action . . . at Booth G-20, the Metal Show.

The Nos. 4 and 10 Radiagraphs will be demonstrated—also on display will be the latest attachments on these machines, the most recently developed apparatus for plate edge preparation, for manual grooving, for welding, cutting and brazing.

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Employment Versus Education

OUR NATIONAL Defense program is causing our engineering colleges to compete with defense jobs in an attempt to fill the classrooms this fall. What will be the outcome?

Students with only two or three years of engineering training are obtaiinng positions paying $250.00 to $300 per month. Positions with salaries that have not yet been obtained by some of the graduated engineers of ten years ago! Yet the only thing that can account for this "boom in engineering jobs" are war threats which have brought about an increase in the number of positions demanding personnel with engineering training.

Naturally, to the young engineer, one still to complete his education, a high salary is very tempting. Why should he go back to school when his salary is higher than that of many of the "old grads"? Apparently he does not realize that the engineer who has fitted himself for the high position has done so by the hard work and experience such a position demands.

The present state of affairs is unstable. For this reason the young engineer should be warned against the adopting of an attitude that is likely to result in disappointment.

First of all, engineering is not a rich man's profession. True, there are engineers who have accumulated vast fortunes but a greater number of engineers and scientists that have become famous in their profession have died poor men. They have been termed great because of their services to humanity. Through their great engineering projects and their inventions they have contributed to the comfort and welfare of their fellow men. Consequently their lack of worldly goods has in no way detracted from their worldly achievements.

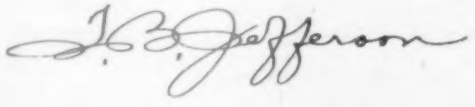
Great wealth is too often taken to denote success. Usually, to an engineer, wealth is secondary — naturally, all of us would like to have sufficient means "to take it easy." To the true engineer, however, sufficient resources to take life easy means that he is assured the time and money to ferret out those scientific details that had eluded his fellow worker who has been less fortunate.

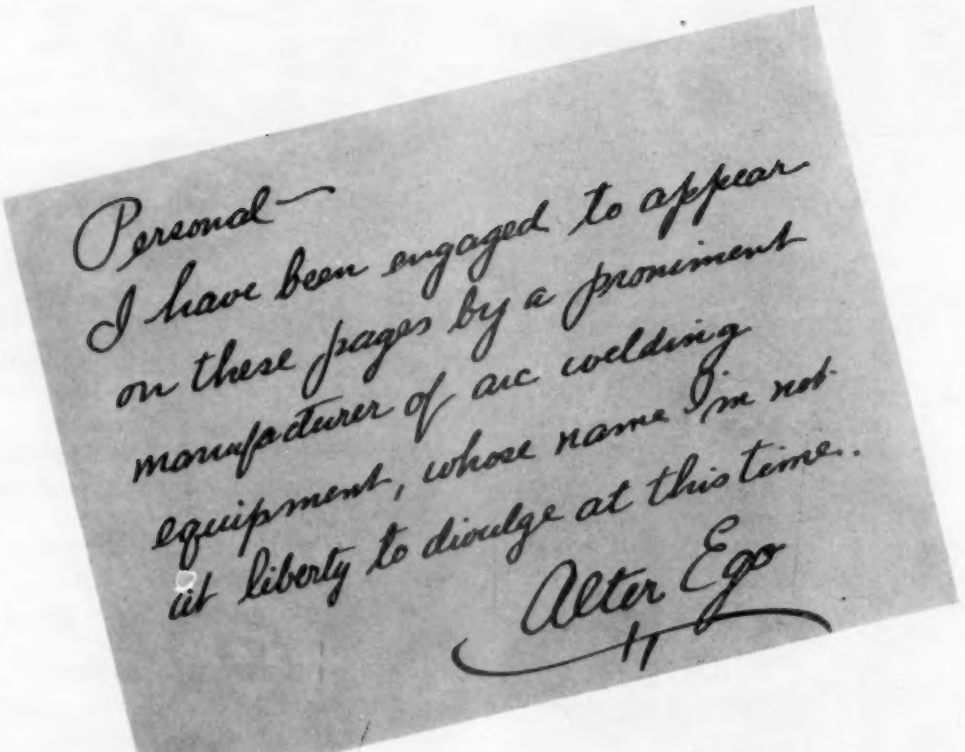
The fear of great wealth falling on the shoulders of our young engineers is not the reason for warning them against being tempted to quit school for big money. Power to them if they can become millionaires, but chances are they won't. An engineer's success or failure is judged to a great extent by his service to mankind. Service that has been rendered through years of wide and varied experience.

Wide and varied experience is not obtained by starting at the top of a salary bracket nor on a routine job; it is gained only by beginning at the bottom and working toward an ultimate goal. Oftimes it appears to be a slow and difficult proceed but usually it affords ample time to learn each lesson before passing on to the next. This is the system that has been used by the great engineers of the past and it is still good—a system of building a firm foundation to insure a secure future.

Getting a raise in salary is a grand experience — even when you feel you should have had even a larger increase. But when you start at the top, raises are difficult to obtain. Frequently, instead of raises, reductions are in order. This will undoubtedly be the case when the present emergency has passed. Nothing can be as disheartening as the experience of working harder for less salary. The loss of heart for a particular job often results in a loss of the job itself. Consequently, disappointment will be the end of many of our "war boom" rainbows — those high salaried positions for inexperienced youth.

Our engineering college should not have to compete with our National Defense program; back in the classroom is the place for our young engineers. There is the place to learn and learn well. Let the trained men have the places they have earned; so that the young engineer may become properly trained and capable of assuming these places when the time comes.




Personal—
I have been engaged to appear
on these pages by a prominent
manufacturer of arc welding
equipment, whose name I'm not
at liberty to divulge at this time.
Alter Ego

★ RESEARCH

A Hydrogen Defeat Causes

Fish-Eyes in Weld Metal

By JOSEPH A. DUMA

Assistant Metallurgist, Norfolk Navy Yard, Norfolk, Va.

★ A new theory on fish-eye formation is presented. The cause, appearances and means for eliminating fish-eyes are discussed.

WHILE THE subject of fish-eyes is still fresh and uppermost in current welding discussions the following additional facts and observations pertaining to them are made.

Two causes regarding the formation of fish-eyes are being prominently featured in recent welding literature, namely: microscopic particles of mechanically entrapped slag, irregardless of the structural constitution of the deposit; and, depending on interpass temperature, either a heterogeneous condition of microstructure possessing differential ductility, or incipient micro cracks developed by the drastic quenching undergone by filler metal when deposited on unpreheated base material. Miss Ferguson is the discoverer of the first cause(1)* and Bela Ronay is the exponent of the latter two causes(2).

*The numbers in parenthesis refer to the bibliography, at the end of the article.

The writer's findings and observations on the subject phenomenon lead him to believe that it is hydrogen gas, and not inclusions, nor incipient cracks, nor differential ductility, that is the real progenitor of fish-eyes. The writer hastens to add that the hydrogen theory does not clash with the observations of either of the above investigators. On the contrary, it uses them as complementary parts of a whole, fitting each into its proper place, and thus obtains a more complete picture of the mechanism behind fish-eye formation.

Fish-eye Theories

The causes advanced by Miss Ferguson and Mr. Ronay contain within them certain inexplicable anomalies. For instance, with regards to inclusions acting as foci for fish-eyes, all shop-made cast steels contain inclusions yet no fish-eyes, except in very rare and special instances, have been observed in the tensile fractures of as-cast specimens. Internal micro cracks too, do not produce fish-eyes. Careful examination of fractures in crack-infested steels (produced by burning, hot tearing, and cold shortness) will generally reveal a local condition very different in geometry and character from fish-eyes. Then again, it is believed that the influence of dieffrential ductility on fish-eye formation has been overestimated for the following reasons.

(a) The change from fine to coarse-grained strata is gradual and not abrupt as it is, let us say, between a large inclusion and the surrounding metal. Therefore the change in ductility is gradual.

(b) The difference in ductility between refined and unrefined areas is not as large as is generally believed. Subsize tensile specimens turned from single-pass fillet welds made with $\frac{5}{16}$ in. electrode, two annealed at 1650 deg. F. and two as-welded elongated thusly:

As-welded

Specimen No. 1 — 26.0%
Specimen No. 2 — 26.0%

Annealed at 1650 deg. F.

Specimen No. 1 — 26.0%
Specimen No. 2 — 30.5%

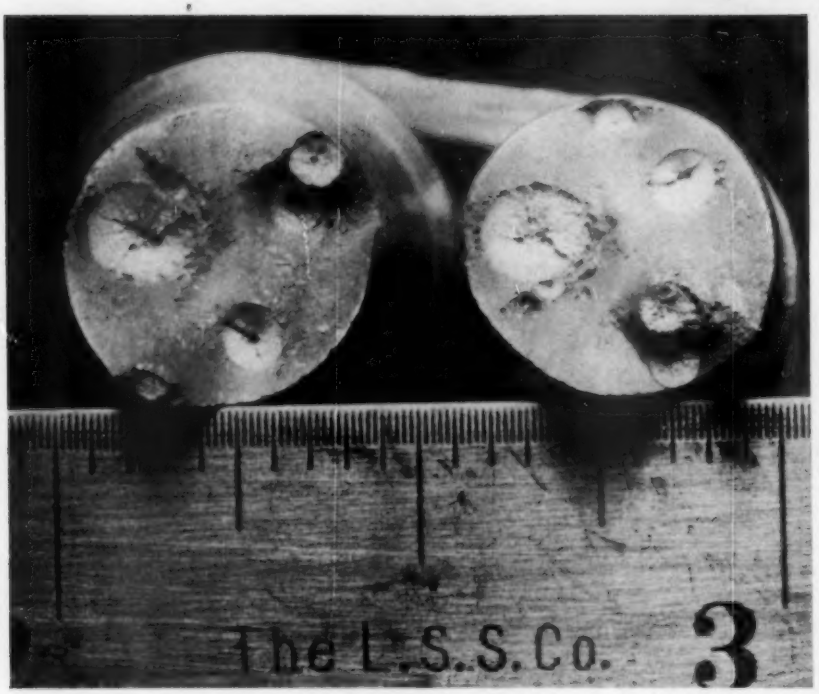


Fig. 1—The general appearance and character of fish eye defects in weld metal tensile test specimens.

Another set of values obtained on V-butt welds, one made with a ¼ in. electrode in one pass, and the other with three electrodes using ⅛ in. rod in the root, $\frac{5}{32}$ in. in the intermediate layer, and ¼ in. for the top finishing pass, are as follows:

As-welded
(one pass)
24.5% elong.
Weld-annealed
(3 passes)
33.0% elong.

A large part of this difference is probably due to the use of electrodes of different size and make.

(c) Though they have a manifest predisposition to locate in coarse-grained strata, fish-eyes occasionally occur in re-crystallized areas as well.

(d) If differential ductility were the primary cause of fish-eyes it could be argued by the same token that wrought iron (a mixture of non-ductile slag stringers and ductile ferrite) should likewise exhibit them.

Hydrogen Behavior

The following evidence is submitted in proof that hydrogen is the primary cause of fish-eyes. The first part of the evidence is in the nature of a preface to the main theme, dealing with some of the more fundamental aspects of hydrogen behavior as related to steel, while the latter part is given over almost entirely to specific cases.

The first fact that must be determined is — just what gases are present in the arc space? Why pick on hydrogen as being the culprit in the case? Larson(3) identified and found the following volumes of gas liberated by one centimeter of a ¼ in. covered electrode (volume of electrode producing gases — .5 cu. cm.): hydrogen 85.4 cu. cm., carbon monoxide 70.3 cu. cm., water vapor 9.3 cu. cm., carbon dioxide 1.9 cu. cm. (all measured at 100 deg. C. and 760 mm. pressure). Methane is also present, it has been suggested. In addition to the gases given off by the pyrolytic decomposition of the coating, a slight infiltration of atmospheric nitrogen and oxygen through the rushing stream of shielding arc gases occurs. This makes a total of seven gases available for absorption by the steel, namely, — CO, CO_2, CH_4, H_2O, H. N. and O_2.

Of all these gases only hydrogen is known to be soluble in liquid steel (4)(5). Generally, the solubility of compounded gases in liquid iron is so low that they can be said to be insoluble. Kinzel and Egan(6) have shown this to be true of CO and CO_2. The fact that CO and CO_2 are not soluble in liquid steel does not mean that they cannot form voids in steel during solidification. Even though these voids cannot be formed by the physical rejection of CO and CO_2 from solution, these two gases can be rejected by chemical action between the carbon and iron oxide in the steel. This, however, is an entirely different phenomenon and shall not be further discussed herein.

Other Cases

It is very doubtful whether methane (CH_4) does or can dissolve in liquid steel. Careful studies of the pyrolysis of methane disclose the important fact that it ultimately either changes under the action of high heat (electric arc(7), and 1000 deg. C.(8)) to hydrogen and some gas like methylene or acetylene, or that it burns in the presence of oxygen to water and CO_2. In both cases, it will be noted, methane is a producer of hydrogen, in the former instance, directly; and in the latter, indirectly through the dissociation of water. Incidentally, there are two distinctly different sources of methane in welding processes: the one internal by a reaction between occluded hydrogen and carbon in the weld metal(9), the other external to the weld metal by the decomposition of cellulose in the coating to gases rich in methane.

Water vapor almost completely dissociates into hydrogen and oxygen at the temperature of liquid steel. The binder in most covered electrodes carries a fairly high percentage of free and chemically combined water (approximately 4.0% and 6.0% respectively). Both gases enter the liquid metal, hydrogen atomically; oxygen, chemically. The latter, in the form of slag inclusions, provides ready abodes for the concentration of hydrogen in the metal.

The elemental gases, oxygen and nitrogen, combine with iron to form iron oxide and iron nitride respectively(10)(11), and thus effect an entrance via the compound way. Regarding nitrogen, there is a lot of disagreement as to whether it is gaseously soluble. It is argued that nitrogen can be present in steel either as iron nitride or gasseous nitrogen depending on

whether the nitrogen in contact with the metal was initially in the molecular or atomic condition. The quantity of monatomic nitrogen in the electric arc is probably small. Larson(3) apparently found no nitrogen in the arc when he analyzed the same for gases.

It is evident then, that of the gases discussed, only hydrogen and probably nitrogen can be physically trapped in, or rejected from, solid solution. Also, that the former is more abundant than the latter.

Temperature Effects

As stated in an earlier paragraph, hydrogen is the predominant element in the gasseous envelope surrounding the arc. It is derived chiefly from the core itself (charged with hydrogen during pickling(12), occasional rust on the core wire, moisture in the materials of the coating, and the combustion of cellulose which is probably the most prolific source of hydrogen.

Sieverts and Ham established conclusively that hydrogen dissolves in steel atomically. Inasmuch as the electric arc is one of the most effective dissociators of molecules, there is ample monatomic hydrogen always present and available for absorption. The above investigators also demonstrated that the quantity of atomic hydrogen dissolvable in steel is a function of pressure and temperature. Specifically, the quantity of hydrogen that will be absorbed is directly proportional to the square root of the pressure. The variation of solubility with temperature ($P_H = 760$ mm) is shown in Fig. 2. The curve shows a sharp decrease in solubility with decreasing temperature and a very decided drop in solubility during solidification, approximately 12.3 cu. cm. hydrogen being rejected from 100 grams of iron while freezing. It is evident that such a sharp decrease in solubility with decreasing temperature will cause a high degree of supersaturation to obtain when steel is cooled from saturation at elevated temperatures. A still higher degree of supersaturation will be obtained in the metal if the melt is drastically chilled or instantly immobilized from an extremely high temperature (4000-5000 deg. F.), as it often does, for instance, in welding processes. Equilibrium reactions being denied, retention of more hydrogen is favored.

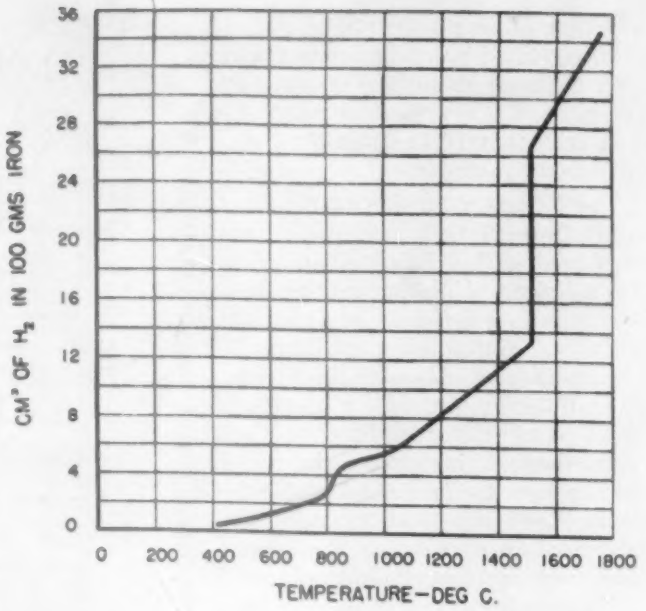


Fig. 2 — Solubility of Hydrogen in iron PH_2 760 mm.

Atomically dissolved hydrogen is difficult to retain in solid solution. To prevent the falling out of the excess gas from the iron lattice tremendously high pressures of hydrogen acting on the outside of that lattice are required. As the decrease in solubility is more than one thousand-fold between the temperature of liquid steel and room temperature, over a thousand-fold increase in the partial pressure of atomic hydrogen would be required to counterbalance the precipitation pressure of hydrogen in cold steel. In the absence of counter pressure, dissolved hydrogen atoms are set in motion through the metallic space lattice by internal forces incident to systems in unstable equilibrium. The rate of movement or diffusion decreases logarithmically with decreasing temperature and continues until either equilibrium pressure is attained, or the excess hydrogen is removed from the steel lattice, or the metal ruptures.

Diffusion rids the steel lattice of nearly all atomic hydrogen, trapping it in discontinuities in the metal and at the same time causing it to recombine and form molecular hydrogen. The latter is considered too large for any further diffusion.

The following discontinuities provide space for the accumulation of compressed hydrogen: tiny cavities such as those caused by micro-shrinkage in the dendritic interstices during freezing; pinhole voids formed by the ejection of trapped gases; grain boundaries and disjunctions of interfering dendrites and neighboring crystalline units; and points of weakness such as the interfaces of inclusions where there may be a lack of contact between inclusion and metal occasioned by unequal shrinkage and cooling. This, in part, explains the disagreement between different observers as to the location of fish-eyes.

Hydrogen-flaked Steel

Occlusion of molecular hydrogen is a highly irreversible phenomenon, gas once trapped cannot get out except when the geometry of the discontinuity is favorable to dissociation and re-solution(13). Heating the metal to temperatures above the gamma to alpha transformation will of course also effect appreciable re-solution of the gas. The relative inability of molecular hydrogen to diffuse out of cavities at low temperatures accounts for the great, and often steel rupturing, pressures that obtain within them. Local concentrations of pressure of this character are not uncommon in hydrogen-flaked steel. In a bibliography appended to a recent article by Zapffe and Sims(13) are listed the works of several hundred authors attesting to the phenomenal ability of hydrogen to create pressure, and withal internal straining and cracking of steel (see Fig. 3).

A rather unique property of pressures obtained by occlusion is that, with a constant supply of atomic hydrogen, these pressures increase at a rate that is undiminished as the pressure increases.

The influence of size of discontinuity on the gas pressure developed within it is tremendous. Not all sizes of discontinuities are productive of fish-eyes or internal ruptures. Extremely small, but numerous and densely dispersed discontinuities provide a general stress within the steel, identified as embrittlement, instead of the previously discussed type of high local stress that leads to observable fissuring. Large voids, on the other hand, require a longer time and take a greater quantity of hydrogen for equivalent pressure. Then too, the occlusion of gas in large cavities is highly irreversible because there is negligible dissociation and the partial pressure of the diffusible atomic hydrogen is almost zero. This means that it is rather difficult to deflate them of their hydrogen at low and room temperatures.

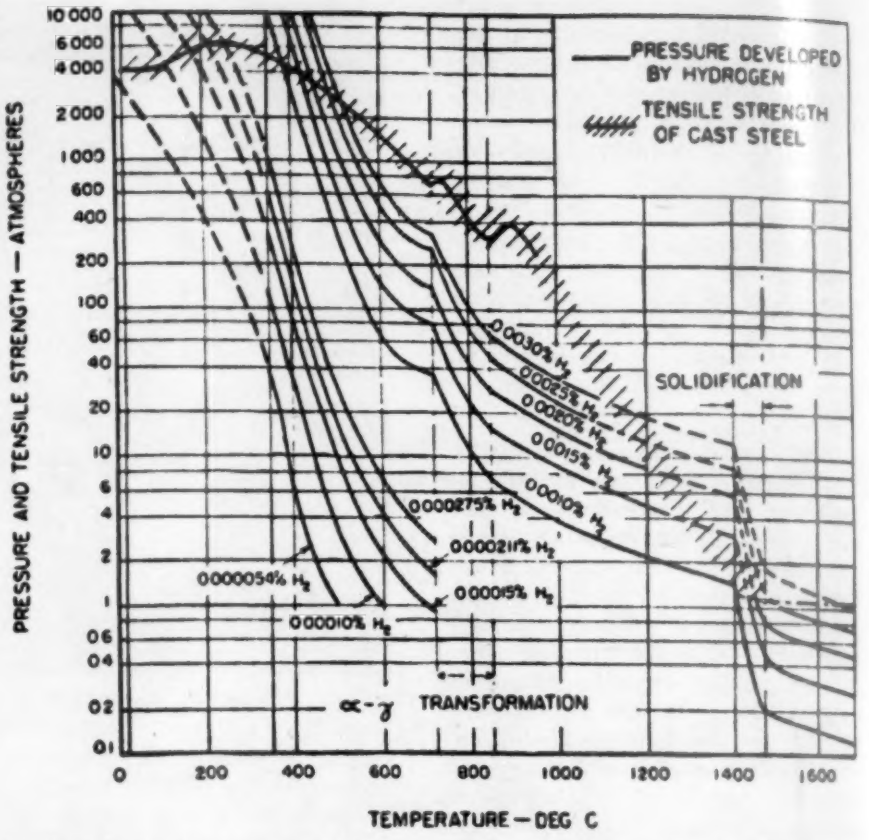


Fig. 3—Calculated variation of hydrogen pressure with temperature of ordinary steel.

To prevent hydrogen infested steels from rupturing internally, prolonged soaking and slow, controlled cooling are used in the temperature range 1100-500 deg. F., the higher temperature requiring the shorter holding time for the escape of hydrogen through the surface of the piece. Internal ruptures (flakes) slowly begin to develop at temperatures between 300-100 dg. F., depending on amount of hydrogen present and size and rate of cooling of the piece. Some pieces do not develop flakes until cooled to room temperature(14).

These, in short, are some of the fundamental habits of hydrogen in steel. Now we come to that part of the discussion which shall attempt to prove that fish-eyes are a hydrogen defect. Reasons for this belief shall be advanced under five main headings, as follows: fracture appearance, occurrence, types of welds, elimination, and hydrogen analyses.

Fracture Appearance

There are definite features in the physiognomy of the defect which bespeak its gas origin. Fish-eyes are circular and slightly conical spots, 1/64th to ⅛th of an inch in diameter, exhibiting a brittle white fracture of two or more concentric rings in contrast with the gray ductile matrix, and often contain one or more radial cracks emanating from a central nucleus (an inclusion, a shrinkage or a gas micro void) and ending in one of the concentric rings. Attention is directed to the fact that the high pressure of gas contained in small discontinuities exerts an aerostatic stress on the metal surrounding the discontinuity, but is not large enough to rupture it without external aid. It takes an externally applied stress to actually initiate fissuring in steel under stress from hydrogen. When the sum of the aerostatic and applied stress exceeds the strength of the steel the metal ruptures internally to the extent indicated by the surrounding circular area, the pressure of the gas is reduced, tearing stops and a flake remains in a plane perpendicular to the direction of that stress. The concentric rings are probably associated with the degree of hydrogen embrittlement about the defect. It is believed that the central nucleus, the circular form, and the brittle break earmark a hydrogen defect.

Occurrence

Fish-eyes occur in the fracture of tensile specimens only. Some observers contend that inclusions initiate fish-eyes; others assign them a dual origin, — attributing their presence to the difference in ductility between fine and coarse-grained strata when the interpass temperature is maintained at or above 200 deg. F., and to microscopic transverse checks when the interpass temperature is allowed to fall to or below that of the ambient air. There are others who hold that both internal cavities and inclusions serve as nuclei for their germination. In this connection it has also been argued that fish-eyes occur in coarse-grained strata exclusively. The writer has found them in both the refined and unrefined areas of metal. Since recrystallization cannot efface some discontinuities (inclusions and cavities), regions of high hydrogen concentration should be discoverable in both kinds of metal. It appears, however, that a greater number of hydrogen defects occur

in unrecrystallized metal. This is probably due to the fact that recrystallization reduces gas pressure. Crystal changes take place at and above the alpha to gamma transformation point, a range of temperature in which appreciable quantities of hydrogen molecules dissociate to hydrogen atoms and subsequently redissolve in the steel lattice. Then too, a tightening of the structure by elimination of coarse, primary grain disjunctions may serve to reduce the available pore space for re-precipitation of hydrogen. The larger voids will, of course, still remain and act as pockets into which hydrogen will again diffuse and precipitate as the weld cools to room temperature. Unrecrystallized metal, on the other hand, is not affected thusly, and therefore remains in its original condition.

Kinds of Deposit

Fish-eyes are not found in all kinds of weld metal. All-position electrodes yield a deposit which when tensilely pulled will nearly always show fish-eyes. This type of electrode is known to be high in cellulose, a prolific source of hydrogen. Unlike the cellulosic variety, mineral coated electrodes are rarely productive of fish-eyed deposits. Needless to add, the hydrogen content of mineral coatings is decidedly lower than that of the organic type. Bare wire deposits, as one might expect, likewise rarely exhibit fish-eyes in their fractures. Nitrides, slag, and CO_2 gas holes embrittle the metal so as to cause it to break with numerous discontinuities and shiny areas in its fracture. None of them, however, are fish-eyes. And finally, weld metal made by the Union-Melt Process very seldom, if ever, contains them. Union-melt welds are made under a thick covering of mineral flux which carries comparatively little hydrogen in its make-up. The foregoing facts are further proof that fish-eyes are associated with hydrogen.

Elimination of Fish-Eyes

The fact that the same heat treatment will eliminate fish-eyes as is generally employed to prevent the formation of flakes in hydrogenized steel also argues strongly in favor of the hydrogen theory. It has been established(14) that flakes slowly begin to develop at temperatures between 300-100 deg. F., depending on the amount of hydrogen present in the steel and on the size and rate of cooling of the piece. Some pieces do not develop flakes until cooled to room temperature for several hours. To prevent flakes from forming in steel containing hydrogen, the steel industry resorts to controlled slow cooling and prolonged soaking in the temperature range 1100-500 deg. F. Since the phenomenon of fish-eye formation is analogous to that of flaking—except with respect to degree or severity — any treatment which cures the latter should cure the former. To test this belief four V-welds, 14 in. long, were made with four different kinds of all-position steel electrodes. Immediately after welding each of the four welds was cut in two half pieces. One set of halves was allowed to cool in air to room temperature, while the other set was placed in a furnace at 450 deg. F. for 8 hours and then slowly furnace-cooled. The following physical properties and condition as to fish-eyes were obtained.

As-welded* (Interpass temperature 200-225 deg. F.)				
Tensile Strength psi.	61,000	68,500	68,750	68,000
Yield Point psi.	48,000	48,750	58,250	54,750
Elong. % in 2 in.	28.0	25.0	17.5	16.5
Reduction Area %	49.5	44.0	27.8	26.8
Fish-eyes	3	3	11	9
Aged 8 Hours At 450 deg. F. (Interpass Temperature 200-225 deg. F.)				
Tensile Strength	60,000	67,250	69,750	68,000
Yield Point	45,500	49,000	58,500	54,750
Elong. % in 2 in.	33.0	29.0	21.5	28.0
Reduction Area	64.7	61.2	42.5	44.8
Reduction Area %	64.7	61.2	42.5	44.8
Fish-eyes	None	None	2	None

*.505 in. tensile specimens; yield point determined by the divider method.

A general improvement in ductility and complete elimination of fish-eyes was obtained in 3 of the 4 specimens. The 4th specimen showed two tiny fish-eye specks not over a $\frac{1}{32}$nd of an inch in diameter. Prolonged aging at low temperatures apparently confers some reversibility upon the otherwise highly irreversible hydrogen, thus appreciably reducing hydrogen stress. All this occurs without any discernible change in microstructure. The percentage of striated, raw weld metal remains the same. Thus again we are compelled to associate hydrogen with fish-eye formation.

Hydrogen Analyses

Accurate analysis for hydrogen is exceedingly difficult. Present methods are faulty in that they measure for the most part only the hydrogen occluded within the steel as molecular hydrogen or as hydrogen reaction products. A significant portion of atomic hydrogen is nearly always lost. Zapffe and Sims(13) recently issued a warning relative to hydrogen analysis in iron and steel, stating in effect that they (hydrogen analyses) should be accepted only with extreme caution. Not infrequently investigations appear wherein some defect in steel might well be explained as the result of hydrogen activity, except that analysis of the steel shows insufficient hydrogen present. This is probably the reason why investigators have failed to detect any positive correlation between fish-eyes and hydrogen content.

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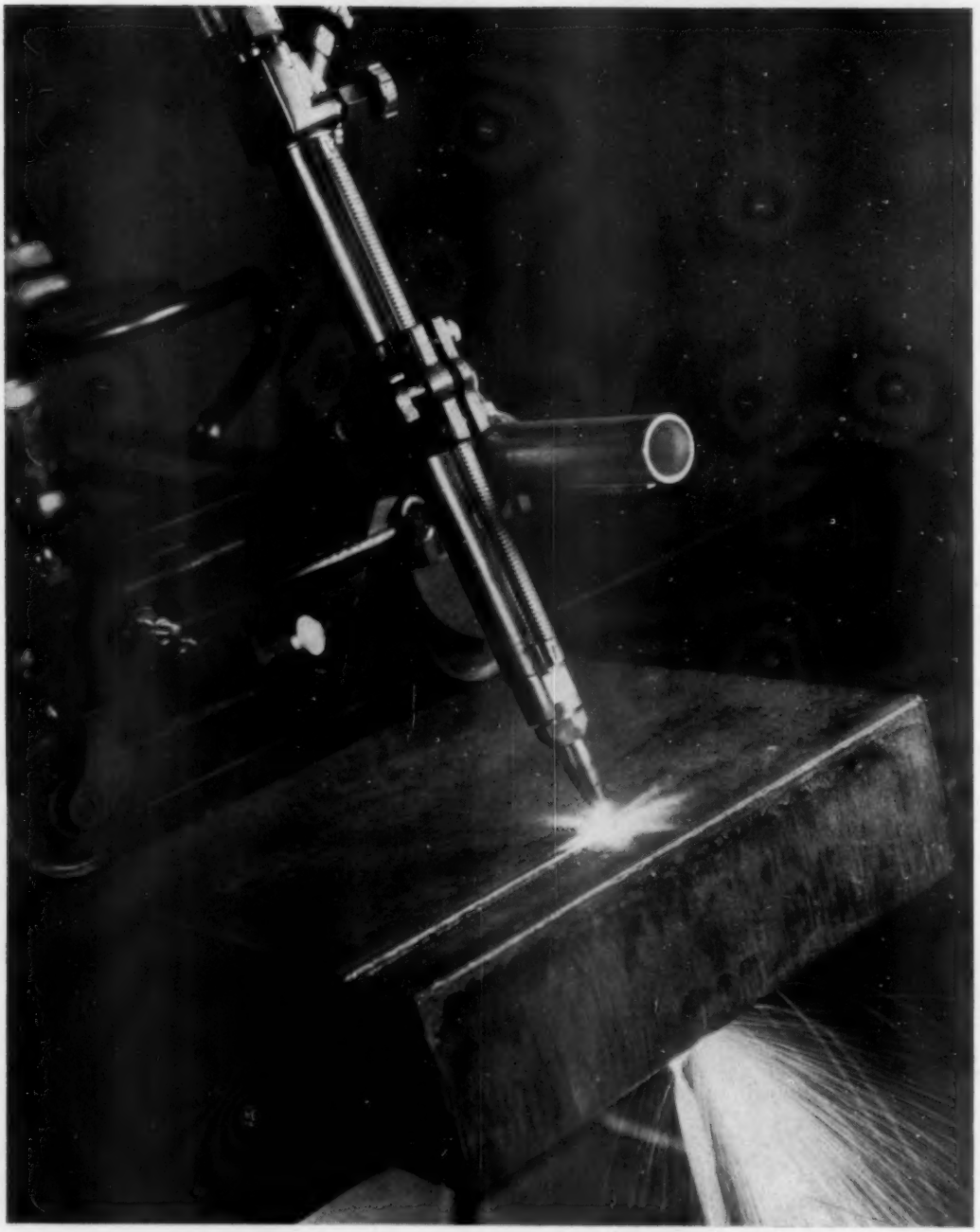


Fig. 1—Flame cutting a 4 in. steel plate. (Photo Linde Air Products Co.)

The present National Defense program will undoubtedly result in a further extension of the use of flame-cutting as a means of shaping steel plates. This method will be used in preference to shearing, stamping and similar mechanical means which once were so commonly used in the shaping and sizing of plates. The speeding up of production in all industries is calling for a faster and more flexible means of shaping steel.

An oxy-acetylene cutting torch regardless of whether it is only a small manually operated torch, a portable cutting machine or a large stationary shape cutting machine, offers the flexibility needed for the cutting of intricate shapes and difficult contours readily and rapidly.

Industrial Uses

In many industries there are complicated items that cannot be fabricated economically when the shapes that make up these parts must be obtained by stamping or shearing. The modern shipyard presents an excellent example of this situation. The plates used in a modern ship are many and varied in shape, yet if the ship is to be of welded construction, the plates must be cut so that they will fit closely to each other. Without accurate fit the welding cost will be increased for more weld metal is required when plates that fit poorly must be joined. In an attempt to obtain the required close fits the plates are sometimes cut too long and instead of butting they may overlap the adjacent plate. If shearing is the method used in shaping the plate, a plate that is too long must be taken back to the shears so that it can be recut to the

Flame-Cutting

for National Defense

By
JAMES T. BARTON

★ An extended use of flame cutting will assist in freeing the "bottlenecks" in the machine tool and foundry industries.

proper length. On the other hand, if flame-cutting is in vogue in the yard, all that is necessary, the only operation required to make the plate fit is a little trimming, while it is in place, using a manually operated torch.

The flame-cutting torch is a speedy tool enabling industry to fabricate parts from steel plate that acording to previous manufacturing standards, were obtainable only in the form of castings.

Thus through flame-cutting equipment it is possible to obtain parts in a few hours that might require days or weeks to obtain from a foundry; the time of delivery depending upon the availability of patterns and the amount of work in the foundry.

Locomotive Frames

Locomotive frame fabrication presents an example where shape cut steel plates has been substituted for steel casting. By flame-cutting the frames of Mallet type locomotives, the time required for the manufacture of this part of the locomotive has been greatly reduced. In Figure 2 may be seen a locomotive frame which has just been flame-cut from a 5½ in. thick S. A. E. 2035 steel slab using a shape cutting machine. This steel slab was 23 ft. long by 34½ in. wide and weighed 14,580 lbs. To reduce the time required for this cutting operation, as well as the gas consumption, the entire steel slab was preheated to between 600 and 700 degrees F. before the cutting operation was begun. The preheating was acomplished by placing the slab in a furnace that had been specially built below the cutting machine's path of travel. In the 97 lineal feet of cutting required to do the job, 5 — 220 cu. ft. tanks of oxygen were used. At that, the entire cutting operation was completed in 3 hours and 15 minutes. Not very long when the time required for the casting of a locomotive frame is considered.

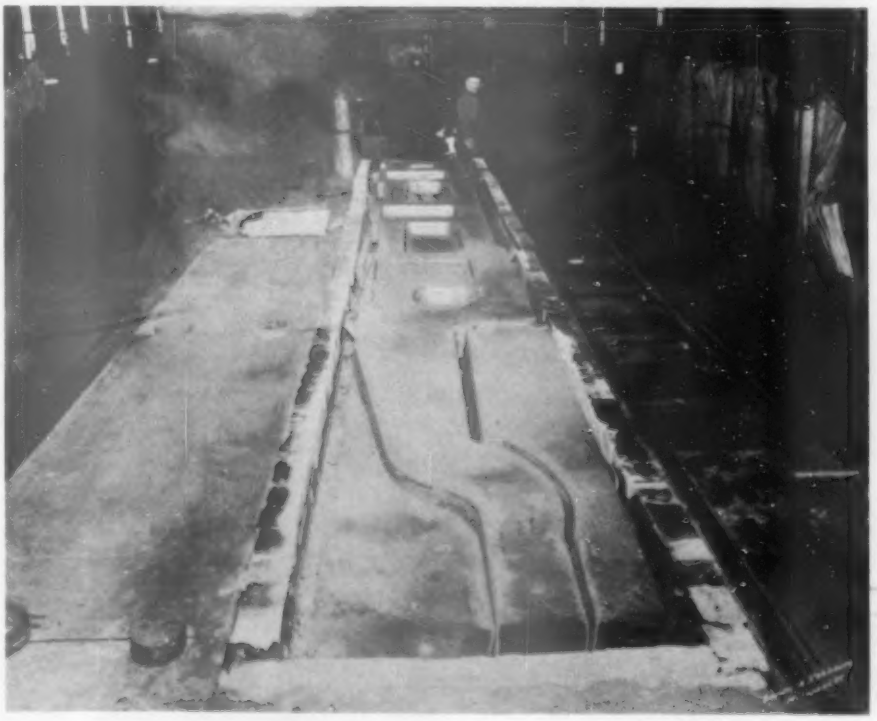
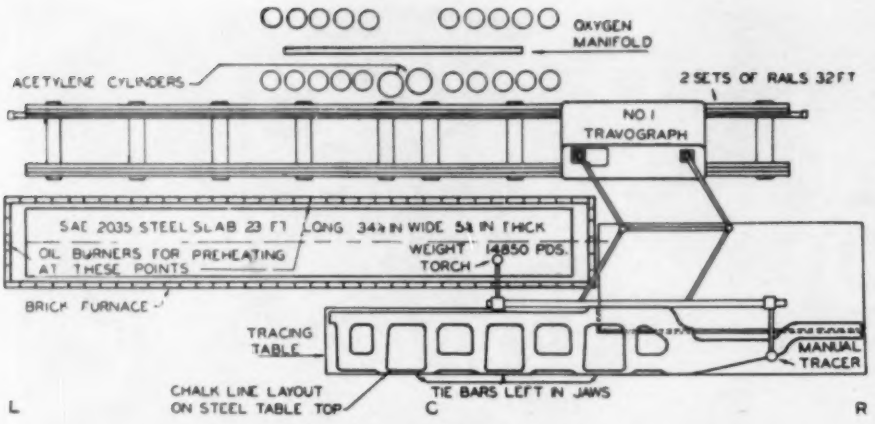


Figure 2—A locomotive frame flame cut from a 5½ in. steel slab. (Photo Air Reduction Sales Co.)

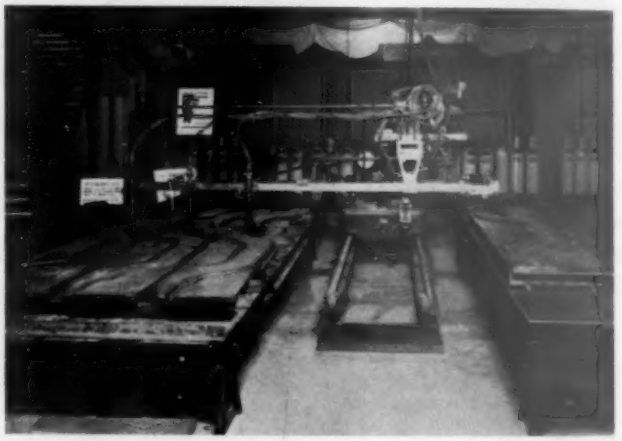


Fog. 3—Plan of shop layout for fabrication of locomotive frames. (Photo Air Reduction Sales Co.)

Preheating

A plan of the shop layout for the flame-cutting of locomotive frames is shown in Figure 3. The flame-cutting machine is mounted on rails so that it may travel back and forth to take in the entire length of the job. The steel slab to be cut is in place in the preheating furnace, while the tracing table is in the immediate foreground. In this plan all pieces of the equipment are shown in their relative position to one another. Manual tracing is used, in the fabrication of locomotive frames, i.e., the operator of the cutting machine, through a pantagraph arm, guides the torch by tracing an outline on the tracing table. The outline may be marked directly on the table or be on a blueprint or drawing that has been placed on the table.

In other industries, especially where there is a repetition of parts, the use of a multiple torch shape cutting machine or the machine cutting of stacked plates will be found advantageous. A multiple torch cutting machine in operation is shown in Figure 4. This machine, which is engaged in the cutting of three identical pieces at one time, is practically automatic in its operation. An operator is required only for the starting of the cut and for stopping the machine when the cut is completed. Once started, a magnetic tracer guides the torch. This magnetic tracer consists of a magnetic roller which has been energized by DC current, because of its magnet attraction the roller is held against the steel cam which has been shaped identical to the part to be cut. Since the magnetic roller is forced to follow the outline of the cam or template guides as it is driven ahead by a small motor, the torch is guided through a pantagraph arm arrangement in such a manner as to make identical flame-cut shapes a natural course of events. The speed of the motor is variable so that the cutting speed may be adjusted to suit the various cutting requirements encountered in cutting plates of different thickness.



Fgi. 4—Multiple torch cutting speeds production. (Photo Air Reduction Sales Co.)

Layout Cutting

All cutting is not done to templates, however. When there are only a few items to be flame shaped, a layout is frequently made on the plate itself. Since only one transmission cover was required on a certain job it was obtained in this manner as may be seen in Figure 6.

The inability of the defense industries to obtain machine tools rapidly is said to be the cause of some of the lagging in production. Flame shape cutting can in a measure help free this bottleneck. Imagine the time that would be required for the production of dies that would be required for the stamping of the 28 pieces that are shown in Figure 5. The pieces, which are required for a machine base, are readily obtainable, how-

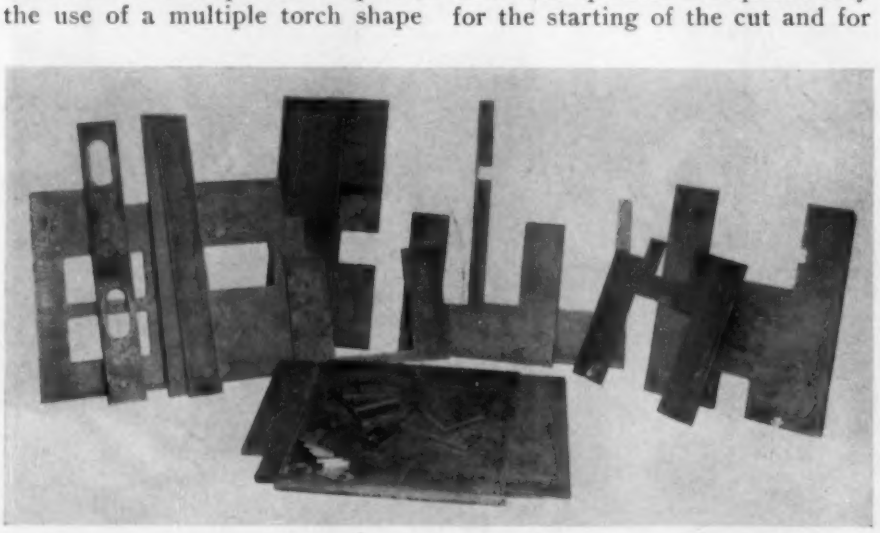


Fig. 5—These twenty-eight flame cut pieces are required for a machine base. (Photo General Electric Co.)

Hard-facing for Steel Mill Equipment Maintenance

By D. B. RICE*

THE PROBLEM of reclaiming or replacing the worn metal on steel mill rolling equipment has always been one of major proportions. Replacement cost of the parts would justify the necessary expenditures for reclamation if the equivalent to original wear were obtained. When increased service life is secured from the built-up part, an appreciable saving of maintenance man-hours and an increased production are accomplished.

Spindles, crabs and coupling boxes, acting as the means of power transmission between the engines or motors, and the rolls, are subjected to extremely severe service. On a continuous type mill the pounding results in wear on one side of the pods only, while on the reversing mill both sides of the pods are active, and the effect is, therefore, doubly pronounced. The efficiency of the mill is materially reduced by wear at these points and frequent replacement is required either with new material or reclaimed parts to keep the equipment within practical working limits. Improper maintenance of separators or stretcher blocks often causes excessive wear. This would ordinarily result in scrapping of the part as being too badly worn for reasonable reclamation. However, by the use of suitable welding materials for the purpose, even badly worn pieces can be reclaimed with the assurance that the additional service to be obtained will offset the expense and an actual profit will be derived from this method of repair.

One of the larger eastern steel plants developed the following repair procedure which has increased several times the service life of some mill parts.

Steel of various analyses is used for spindles and crabs. Predominant in this field, however, are carbon steels ranging from .45 to 55% carbon or the usual 12 to 14% manganese, a material commonly known as Hadfield steel.

In their repair it is sometimes necessary to replace as much as 1½ in. of worn-away material on the sides of the pods and under such conditions there is some variation of materials used if the parts are of .45 to 55% carbon steel. Considering the type of steel first, all spalled or loose metal is removed from the areas to be built up. This is accomplished by means of a cutting torch or by chipping and grinding. The piece is then preheated to a temperature between 400 and 500 degrees F. A carbon steel rod of comparable analysis is used to make the initial deposit and build up these areas to within ½ in. of the finished surface. Each bead must be peened as applied to stress relieve and produce a more dense deposit, thus making the material less susceptible to flow under impact. The additional material needed to complete the build-up to template size is applied with electrodes of nickel-manganese steel, containing 3½ to 4% nickel and 14% manganese, with .75 to .90% carbon. It is essential that each bead of the nickel-manganese deposit be thoroughly peened not only for stress relief, but also to increase the Brinell hardness of the deposited metal toward its ultimate hardness, which is between 400 and 450 Brinell. This operation, it was found, reduces the initial flow of the deposit in service and produces a much smoother finished surface. Any high spots should be removed with a hand grinder when welding has been completed so that all surfaces conform closely to the template. As a measure of precaution to prevent spalling in service, a dovetail or groove should be pro-

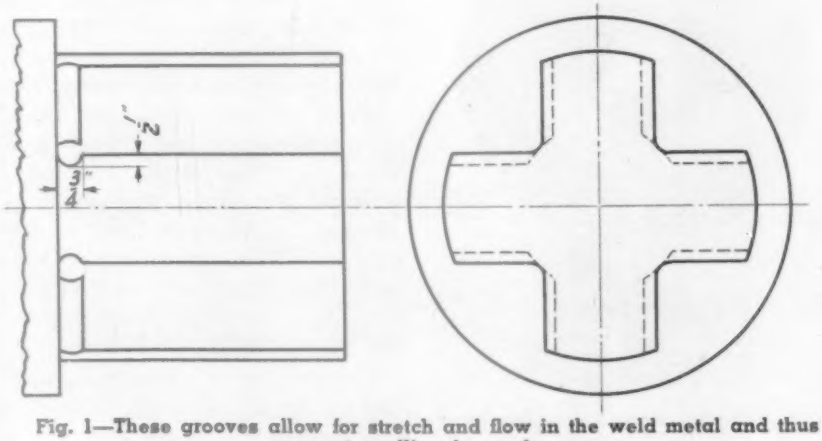


Fig. 1—These grooves allow for stretch and flow in the weld metal and thus prevent spalling in service.

*Welding Engineer, American Manganese Steel Division, Chicago Heights, Ill.

Fig. 2—This standard type coupling box is being rebuilt by hard-facing.

vided at the back of each pod to allow for any stretch or flow of the weld metal which may take place. This groove should be about ¾ in wide and ½ in. deep, as indicated on the sketch. (See Fig. 1)

In case the part is of the Hadfield or 14% manganese steel analysis, loose or spalled material is removed by grinding. Preheat temperatures must be limited to 300 degrees F., as prolonged heating at temperatures above 400 degrees has a detrimental effect on the physical properties of 14% manganese steel. Heating, however, does not affect nickel-manganese steel. The entire build-up is then made with nickel-manganese steel electrodes, as described.

In Figure 2 the subject is a coupling box of standard type and the welder is building it up to normal inside dimensions. Figure 3 indicates the excessive wear that takes place on these parts and details of the built-up areas.

The procedure for reclaiming of coupling boxes follows that of the spindles and crabs insofar as preparation, preheating and general welding practice is concerned. The inital build-up material, however, should be nickel-manganese steel, which is applied to within ¼ in. of finish dimensions. As all deposits are made on the interior of the casting, peening is difficult and the effects of it, in increased hardness of the material deposited, are not as great. To compensate for this condition and also to provide a metal of different analysis and characteristics to work opposite the nickel-manganese applied to the spindles, the final ¼ in. to reach finish dimensions should be deposited with hard facing welding electrodes. A coating of tough, impact and abrasion resistant material, having a Brinell hardness between 450 and 500 as deposited, will thus be provided where the wear and impact are greatest. This hard facing deposit will furnish a dense, smooth deposit free from porosity or other defects and will require very little grinding to produce a surface sufficiently smooth and close to dimensions to be advantageous from a standpoint of wear and adequate bearing.

There is definitely an appreciable saving in maintenance costs to be made in reclamation work of this nature. The procedures detailed above have been tested and proved to accomplish such results.

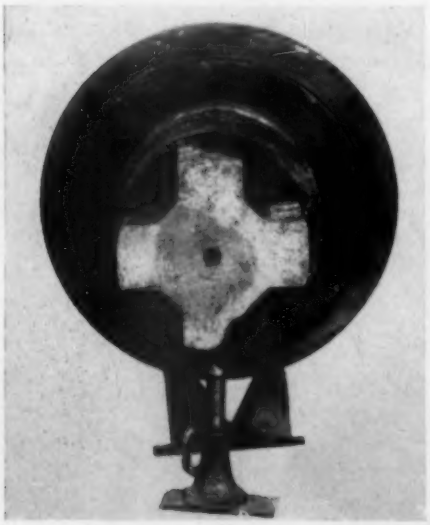


Fig. 3—Note the wear that takes place on the roll pads.

» «

A-C Welding Eliminates Warpage and Enamel Spots

★ Black spots appearing in the vitreous enamels over welds on light gauge steel refrigerator cabinets have been reduced by 90 per cent through use of a AC electric arc welding set. Frame warpage has been eliminated and welding time has been reduced. Another problem encountered was welding ends in the food compartment liners. These liners must be welded on the outside because the inside must take the familiar white vitreous enamel finish.

A-C electric welding has eliminated both these undesirable conditions. Warpage was done away with entirely; and, due to the better control possible with the electric arc, black spots under the enamel were cut 90 per cent. A saving in welding time also resulted, naturally cutting down the labor cost per cabinet. Total time required now, including handling, welding, and cleaning, averages 60-65 seconds per man hour of 50 cabinets.

Greatest saving, however, turned out to be the reduced enamelling cost due to the 90 per cent less refirings now necssary to re-finish black spots which show through the the enamel finish. This is one more of the long line of successful applications which have been taken over by a-c welding, and illustrates the savings obtainable in rejects, refinishing, and welding time; which all combine to produce lowered production costs.

A-C welding for refrigerator cabinets reduces black spots (Photo Westinghouse Electric & Manufacturing Co.)

An aerial view of Downtown Cleveland

Special Insert Devoted to a Pre-View of Two Big Metal-Working Events

Annual Meeting of

American Welding Society

⚙ at Cleveland Hotel

Welding and Cutting Exhibits of

National Metal Exposition

⚙ at Cleveland Public Auditorium

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American

Welding Society

Twenty-first Annual Meeting

★ Cleveland and the Cleveland Hotel will be host to the society. In the 16 technical sessions 53 papers covering every phase of welding will be presented.

Approximately 1500 welding engineers and production men interested in welding are expected at the technical sessions of the forthcoming 21st Annual Meeting of the American Welding Society, which will be held during Convention Week in Cleveland, October 20-25, 1940. The tentative program calls for the presentation of 53 papers covering all phases of welding. All of the A.W.S. technical meetings will be held at the Cleveland Hotel. Other technical societies cooperating with the A.W.S. are the American Society for Metals, the American Institute of Mining and Metallurgical Engineers and The Wire Association.

The convention will be called to order Monday morning, October 21 by President George T. Horton of the American Welding Society. Following the presentation of metals and prizes, the first technical session will begin, starting with a paper on Welding in Shipbuilding by David Arnott, American Bureau of Shipping. The other paper to be presented at this session will be Welded Rigid Frame Structures by A. Amirikian, Navy Department.

There will be simultaneous technical sessions on every day of the Convention, both morning and afternoon, with the exception of Thursday afternoon. No technical sessions are scheduled for Thursday afternoon so as to permit welding men to visit the exhibits of the National Metal Exposition at Convention Hall. The annual dinner will be held at 7 P. M. Thursday evening in the Grand Ballroom of the Cleveland Hotel. The banquet this year will differ from those in the past in that there will be no principal speaker.

On Friday morning at 11:30 A. M. is scheduled the annual business meeting of the Society. President Horton will present his report and the election of officers will conclude the meeting. Immediately following the business meeting there will be held the luncheon of the Board of Directors of the Society.

On the following pages will be found a complete tentative program of the Annual A.W.S. meeting in Chicago.

Col. G. F. Jenks, President-elect of the American Welding Society

MONDAY—OCTOBER 21st

9:30 A.M.—Morning Session

Chairman: GEORGE T. HORTON, President, American Welding Society.

Vice-Chairman: C. A. MCCUNE, Chairman, Convention Committee.

PRESENTATION OF MEDALS AND PRIZES

10:30 A.M.—Technical Session

Chairman: F. M. SCOTTEN, Great Lakes Engineering Works.

Vice-Chairman: C. A. LOOMIS, Bureau of Construction & Repair, Navy Dept.

SHIPBUILDING AND STRUCTURAL

"Welding in Shipbuilding," by DAVID ARNOTT, American Bureau of Shipping.

"Welded Rigid Frame Structures," by A. AMIRIKIAN, Navy Department.

2:00 P.M.—Simultaneous Technical Sessions

STEEL MILL

Chairman: MILTON MALE, U. S. Steel Corporation of Delaware.

Vice-Chairman: R. E. KINKEAD, Consulting Engineer.

"Resistance Flash Welding of Strip in Steel Mills," by J. H. COOPER, Taylor Winfield Corporation.

"Design and Fabrication of Heavy Rolling Mill Machinery," by G. W. LINKHAUER, United Engineering & Foundry Co.

"Shape Cutting in Steel Mill," by JOSEPH STANLEY, Carnegie Illinois Steel Corporation.

"Hard Facing Steel Equipment," by FRANK L. GRAY, Carnegie Illinois Steel Corporation.

George T. Horton, President of the American Welding Society

INDUSTRIAL RESEARCH

Chairman: J. H. CRITCHETT, Union Carbide & Carbon Research Laboratories.

Vice-Chairman: E. VOM STEEG, General Electric Co.

"Testing for Weldability of Carbon Steels," by C. E. JACKSON and G. G. LUTHER, Naval Research Laboratory, Anacostia Station.

"Defects in Weld Metal and Hydrogen in Steel," by CARL A. ZAPFFE and C. E. SIMS, Battelle Memorial Institute.

"Improving Ductility of Oxyacetylene Welds by Aging," by J. R. DAWSON and A. R. LYTLE, Union Carbide & Carbon Laboratories.

"Metallurgical Changes at Welded Joints, and the Weldability of Steels," by R. H. ABORN, U. S. Steel Corporation Research Laboratory.

7:30 P.M.—Evening Session

Industrial Research Conference—G. F. JENKS, Chairman, presiding.

TUESDAY—OCTOBER 22nd

9:30 A.M.—Simultaneous Technical Sessions

MACHINERY

Chairman: A. E. GIBSON, Wellman Engineering Co.

Vice-Chairman: E. V. DAVID, Air Reduction Sales Co.

"Operation Problems in the Small Welding Shop," by ROGER B. WHITE and J. T. LEWIS, JR., Lewis Welding & Engineering Corp.

"Welding Electrical Machinery," by R. A. TAYLOR, Westinghouse Elec. & Mfg. Co.

"Recent Developments in Flame Machining," by H. E. LANDIS, JR., and J. G. MAGRATH, Air Reduction Sales Co.

FUNDAMENTAL RESEARCH

Chairman: J. J. CROWE, Air Reduction Sales Co.

Vice-Chairman: F. C. FYKE, Standard Oil Development Co.

"A Method of Studying the Effects of Inertia and Friction in Resistance Welding Machines," by W. F. HESS and R. A. WYANT, Rensselaer Polytechnic Institute.

"The Welding of Carbon-Molybdenum Piping for High Temperature - High Pressure Service," by R. W. EMERSON, Pittsburgh Piping & Equipment Co.

"Micro-Fissuring in Multiple Bead, Low Carbon Steel Welds," by J. L. MILLER and L. R. KOVAC, Armour Institute of Technology.

2:00 P.M.—Simultaneous Technical Sessions

MACHINERY

Chairman: K. L. HANSEN, Harnischfeger Corporation.

Vice-Chairman: H. H. DYAR, The Linde Air Products Co.

"Flame Hardening," by R. H. ZIELMAN, Thew Shovel Co.

"Production Flame Hardening of Machine Parts," by JOHN ERLER and P. H. TOMLINSON, Farrel-Birmingham Co., Inc.

"High-Speed Mechanized Oxyacetylene Welding," by H. T. HERBST, The Linde Air Products Co.

"Machine Flame Cutting in Preparation for Welding," by W. ROY WIDDOES, By-Products Steel Corp.

"Use of Welding and Cutting in the Fabrication of Ditching Equipment," by A. R. ASKUE, Cleveland Trencher Co.

FUNDAMENTAL RESEARCH

Chairman: O. T. Barnett, Black, Sivalls & Bryson, Inc.

Vice-Chairman: R. E. Powell, Western Electric Co.

"Welded Girders With Inclined Stiffeners," by Cyril Jenson and C. Antoni, Lehigh University.

"Measurement of Contact Resistance," by W. B. Kouwenhoven and Joseph Tampico, Johns Hopkins University.

"Electrodes for Welding Cast Iron," by G. S. Schaller, University of Washington.

"Fundamentals of Resistance Welding," by R. S. Pelton, General Electric Co.

7:30 P.M.—Evening Session

"Fundamental Research Conference"—H. M. Hobart, Chairman, presiding.

WEDNESDAY, OCTOBER 23rd

9:30 A.M.—Simultaneous Technical Sessions

RESISTANCE WELDING

Chairman: L. W. Clark, The Detroit Edison Co.

Vice-Chairman: A. L. Pfeil, Universal Power Corp.

"Resistance Welding Electrodes—Some Fundamental Considerations," by G. N. Sieger, S-M-S Corporation.

"Changes in the Shape of Spherical Spot-Welding Electrodes," by W. F. Hess and R. A. Wyant, Rensselaer Polytechnic Institute.

"Recorders and Indicators for Resistance Welding Machines," by W. C. Hutchins, General Electric Co.

FUNDAMENTAL RESEARCH

Chairman: A. S. Douglass, The Detroit Edison Co.

Vice-Chairman: A. F. Davis, The Lincoln Electric Co.

"The Effect of the Physical State of Steel Upon the Tensile Strength of Brazed Joints," by F. C. Kelley, General Electric Co.

"Causes of Crater Formation," by G. E. Doan, Lehigh University.

"Cold Rolling Testing of Welds," by T. P. Hughes and R. L. Dowdell, University of Minnesota.

2:00 P.M.—Simultaneous Technical Sessions

RESISTANCE WELDING

Chairman: M. S. Clark, Federal Machine & Welder Co.

Vice-Chairman: J. D. Gordon, Taylor-Winfield Corporation.

"Scope and Limitations of the Stored Energy Type Resistance Welding," by C. Weygandt, Moore School of Eng., Univ. of Pennsylvania, and G. S. Mikhalapov, Baldwin Southwark Div., The Baldwin Locomotive Works.

"A Study of Spot Welding on a Copper Base Alloy," by M. L. Wood, J. Babin and O. B. Atkin, Chase Brass & Copper Co.

"Stored Energy Systems of Spot Welding," by H. B. Axtell and R. L. Ringer, Jr., Taylor-Winfield Corp.

"Electro-Brazing Methods," by R. J. Wensley, I-T-E Circuit Breaker Co.

"Spot Welding in Aircraft Construction," by C. F. Marschner, McDonnell Aircraft Corp.

STRUCTURAL

Chairman: H. O. Hill, Bethlehem Steel Co.

Vice-Chairman: J. M. Driscoll, Air Reduction Sales Co.

"Shall We Weld Our Bridges?" by Fred L. Plummer, Hammond Iron Works.

"Flexible Welded Angle Connections," by Bruce Johnston and L. F. Green, Lehigh University.

"Design and Construction of Arc-Welded Steel Structures," by LaMotte Grover, Air Reduction Sales Co.

"Flame Cleaning of Structural Steel," by F. H. Dill, American Bridge Co.

THURSDAY, OCTOBER 24th

9:30 A.M.—Simultaneous Technical Sessions

PIPE WELDING

Chairman: E. A. Doyle, The Linde Air Products Co.

Vice-Chairman: E. T. Scott, Cleveland School of Welding, Inc.

"Pipe Welding for the Naval Service," by Bela Ronay, U. S. Naval Eng. Exp. Station.

"Welding of Copper and Red Brass," by J. J. Vreeland and J. Babin, Chase Brass & Copper Co.

"Investigation of Gas and Arc Fillet Welds in Piping," by I. H. Carlson and Eric R. Seabloom, Crane Company.

"Preheating—Welding—Normalizing," by C. J. Holslag, Electric Arc Cutting & Welding Co.

PROCEDURE CONTROLS AND SPECIAL APPLICATIONS

Chairman: H. C. Boardman, Chicago Bridge & Iron Co.

Vice-Chairman: F. L. Plummer, Hammond Iron Wks.

"Cost and Procedure Control by Use of Polarized Light," by E. W. P. Smith, The Lincoln Electric Co.

"Training of Welding Operators," by S. Lewis Land, Supervisor of Industrial Education, N. Y. State Dept. of Education.

"Codes for Welded Pressure Vessels," by D. S. Jacobus, Babcock & Wilcox Co.

"Aircraft Welding," by Hanford Eckman, Piper Aircraft Corp.

"Design and Construction of Large Welded Cement Kilns," by C. A. Malmberg, Allis-Chalmers Mfg. Co.

2:00 P.M.—Committee Meetings

7:00 P.M.—Annual Banquet

FRIDAY, OCTOBER 25th

9:30 to 11:20 A.M.—Simultaneous Technical Sessions

METALLURGICAL

Chairman: A. B. Kinzel, Union Carbide & Carbon research Laboratories.

Vice-Chairman: E. E. Thum, American Society for Metals.

"Properties of 18-8 Weld Deposits," by K. W. Ostrom, Arcos Corporation.

"Silver and Alloy Soldering," by C. Zappone, Robertshaw Thermostat Co.

RAILROAD

Chairman: D. S. Ellis, Chesapeake & Ohio R. R.

Vice-Chairman: H. M. Priest, Railroad Research Bureau, U. S. Steel Subsidiaries.

"Welding in Tank Car Construction," by J. W. Sheffer, American Car & Foundry Co.

"Welding of Passenger Cars," by A. M. Unger, Pullman-Standard Car Mfg. Co.

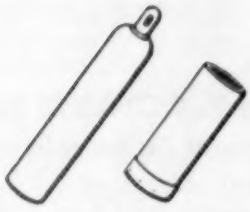
11:30 A.M.—Business Meeting

Chairman: George T. Horton, President, American Welding Society.

Annual Report of the President.

Election and Installation of New Officers.

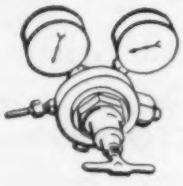
Presentation of Past-President's Pin.



To reduce oxygen and acetylene consumption,

to easily maintain the ideal flame,

use the best possible regulators and



be sure to

look for maximum safety — and their ability to stay on the job

longer.

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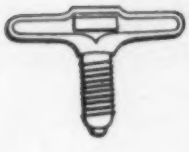

with large, polished, stainless steel ball end

sheridized steel inlay sleeve

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die forged body and spring housing make

these regulators serve you longer

Diaphragm

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and stops prevent excessive up-and-down

movement

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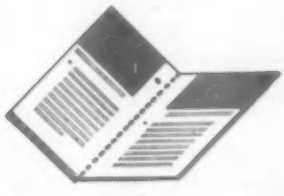
catalog  ☆ Victor Equipment Company ☆ 844-50

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Exhibits of Interest to the Welding Industry

A

Acme Electric Welding Co. B-32
Air Reduction Sales Co. G-20
Allegheny Ludlum Steel Corp. A-1
Allis-Chalmers Mfg. Co. Z-231
Aluminum Co. of America D-22
American Brass Co. E-22
American Chain & Cable Co. G-4
American Gas Association ..... Ind. Gas Ex.
American Institute of Mining and Metallurgical Engineers Y-18
American Machinist Z-232
American Manganese Steel F-35
American Rolling Mill Co. E-16
American Steel & Wire Co. Z-104
American Welding Society Y-44
Ampco Metal, Inc. Y-26
Arcos Corp. C-27

B

Babcock & Wilcox Co. Y-54
Baldwin Southwark B-27
Bastian-Blessing Co. F-9
Bethlehem Steel Co. A-22
Blakeslee & Co., G. S. H-7
Bridgeport Brass Co. Y-27

C

Carboloy Company, Inc. Z-115
Carborundum Co. E-32
Carnegie-Illinois Steel Co. Z-104
Carpenter Steel Co. E-27
Chase Brass & Copper Co. C-21
Clark Controller Co. E-28
Cleveland Crane & Engineering Co. Z-130
Climax Molybdenum Co. E-14
Compressed Industrial Gases G-40, G-42, H-40
Copperweld Steel Co. F-20
Crucible Steel Co. of America Y-6

D

Detroit Testing Machine Co. X-1
Dow Chemical Co. Y-58

E

Eisler Engineering Co. D-29
Electric Controller & Mfg. Co. B-29
Electro Metallurgical Co. D-14
Expert Welder Co. B-32

F

Federal Machine & Welder Co. D-34
Firth Sterling Steel Co. X-11

G

General Electric Co. A-11
General Electric X-Ray Corp. A-11

H

Halcomb Steel Co. Y-6
Harnischfeger Corp. E-20
Harris Calorific Co. Z-202
Haynes-Stellite Co. D-14
Heltzel Steel Form & Iron Co. E-1
Hobart Brothers Co. C-28
Hollup Corp. H-40, G-40, G-42

I

Illinois Testing Labs., Inc. I-12
Industrial Publishing Co. F-36
Ingersoll Steel & Disc. Co. C-9
International Nickel Co. B-8
Iron Age Y-23

J

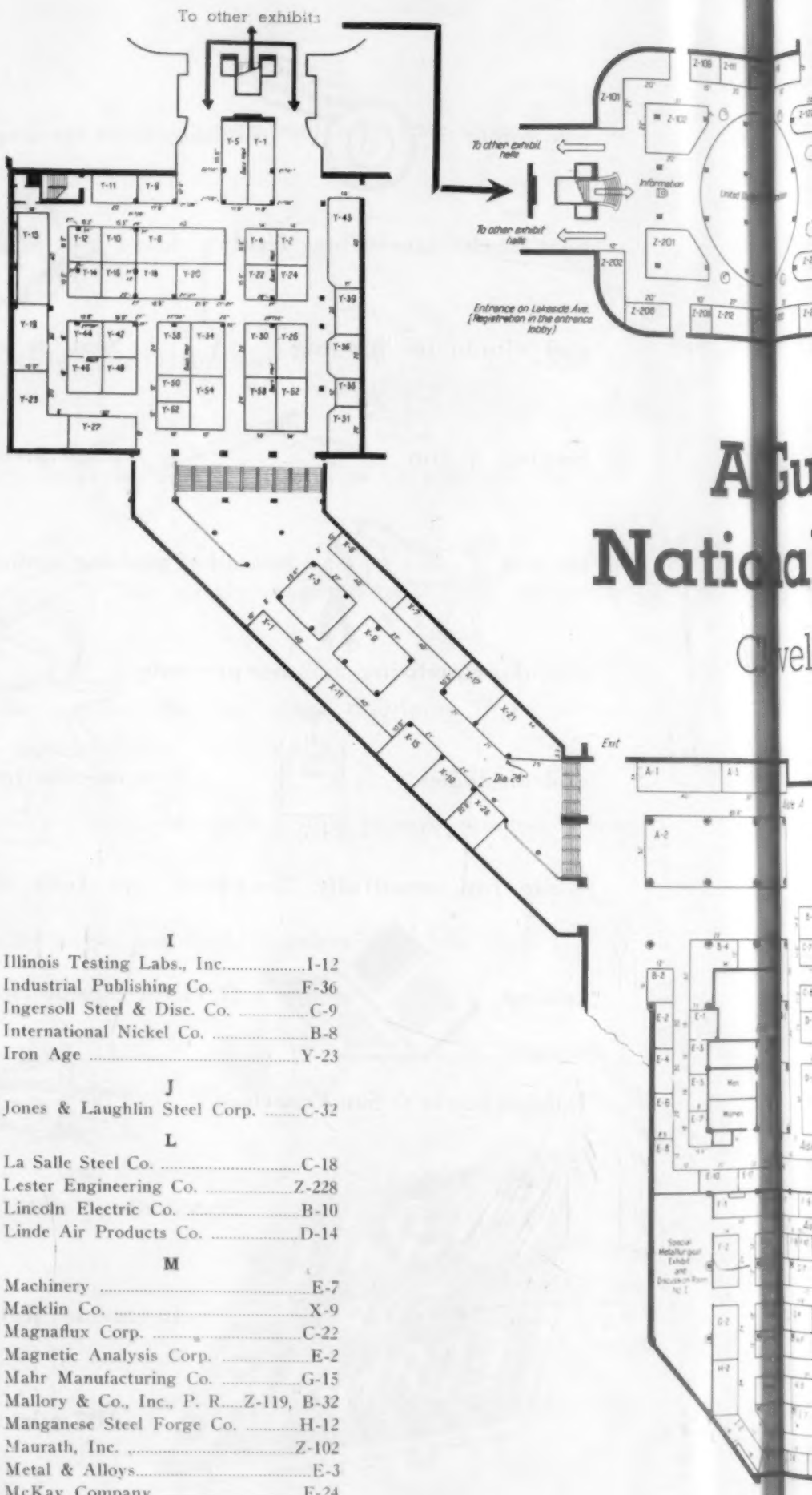
Jones & Laughlin Steel Corp. C-32

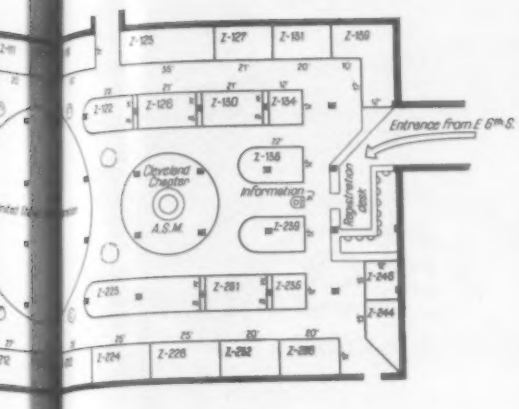
L

La Salle Steel Co. C-18
Lester Engineering Co. Z-228
Lincoln Electric Co. B-10
Linde Air Products Co. D-14

M

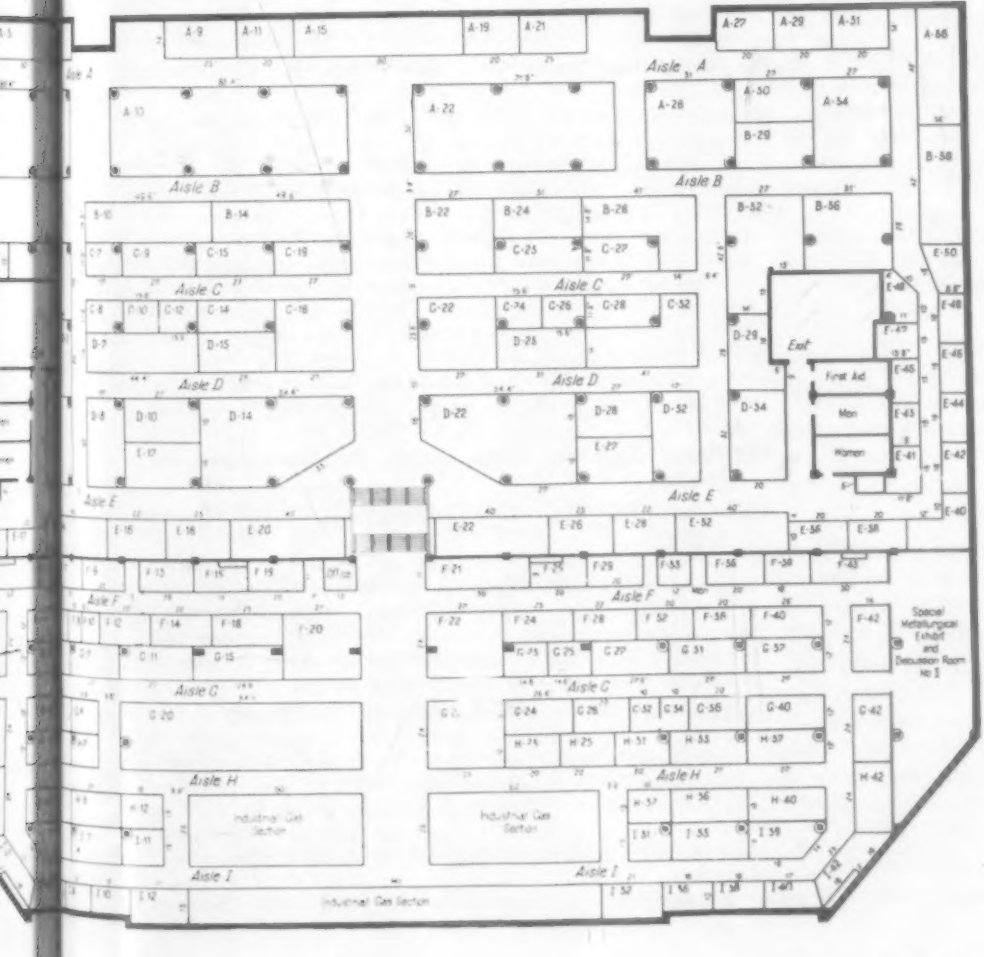
Machinery E-7
Macklin Co. X-9
Magnaflux Corp. C-22
Magnetic Analysis Corp. E-2
Mahr Manufacturing Co. G-15
Mallory & Co., Inc., P. R. Z-119, B-32
Manganese Steel Forge Co. H-12
Maurath, Inc. Z-102
Metal & Alloys E-3
McKay Company F-24





A Guide to the 1940 ional Metal Exposition

Cleveland Public Auditorium



M (con't)

Metal & Thermit Corp. D-3
Molybdenum Corp. of America A-1
Multi-Hydromatic Welding & Mfg. Co. B-32

N

National Carbide Corp. G-20
National Carbon Co. D-14
National Cylinder Gas Co. G-40, G-42, H-40
National Electric Welding Machines Co. C-30
Norton Company A-8

O

Olsen Testing Machine Co., Tinius C-15
Otis Steel Co. Z-126

P

Page Steel & Wire Div. G-4
Partlow Corp. ..... Ind. Gas Exhibit
Pittsburgh Crucible Steel Co. Y-6
Progressive Welder Co. D-30

R

Ransome Concrete Machinery Co. E-12
Republic Steel Corp. A-10
Resistance Welders Mfrs. Assoc. B-32
Revere Copper & Brass Co. X-19
Riehle Testing Machine Y-22
Roebling's Sons Co., John A. F-2
Ruemelium Mfg. Co. F7-A
Rustless Iron & Steel Corp. Y-31

S

Sciaky Corp. A-34
Stanley Electric Tool Div. F-7
Steel X-21
Sterling Grinding Wheel Co. Z-131
Stoody Co. D-32
Swift Electric Welder Co. B-32

T

Taylor-Hall Welding Corp. B-37
Taylor Winfield Corp. B-36
Thomson-Gibb Electric Welding Co. B-32
Tinins Olsen Testing Machine Co. C-15
Titanium Alloy Mfg. Co. F-13

U

Una Welding, Inc. X-15
Union Carbide Corp. D-14
United States Steel Corp. Z-104

V

Vanadium Alloys Steel Co. D-23
Vanadium Corp. of America Y-2

W

Wall-Colmonoy Corp. Y-39
Welding Engineer Y-48
Welding Engineering Co. I-4
Welding Machines Mfg. Co. C-33
Welding Sales & Engineering Co. B-32
Westinghouse Electric & Mfg. Co. B-22
Williams & Co. H-33
Wilson Welder & Metals Co. G-20
Wire Association F-32

Y

Youngstown Sheet & Tube Co. F-18

Cleveland Public Auditorium

This Year's

National Metal Exposition

Will Be the Largest

NATIONAL DEFENSE will be the theme of the National Metal Exposition which will be held at the Cleveland Public Auditorium the week of October 21st. This annual display which is widely recognized as one of the country's largest industrial expositions, will be larger than ever before. All of the latest developments in welding, cutting, metallurgy, heat-treating and fabricating will be depicted by means of ingenious displays and working models and demonstrations.

The doors of the Public Auditorium will open at 12 noon, Monday, October 21st and remain open every afternoon and evening throughout the week. The convenient location of the Public Auditorium to the various hotels at which the cooperating societies are holding their annual meetings will make it possible for all to visit frequently the more than 275 exhibits housed there. The nation's leading metal producers and equipment manufacturers in the metal fabricating field have signed up for exhibit space at the National Metal Exposition.

Of these exhibitors, 118 exhibits are of special interest to welding engineers and men interested in welding and cutting processes. In order to help our readers locate these welding exhibits, there is included on pages 42 and 43, a guide to the National Metal Exposition giving a floor plan of the Public Auditorium and an index to the exhibitors of interest to the welding industry.

Reviewing the list of exhibitors, it is apparent that many key men in the welding, heat-treating and metallurgical fields will be in attendance at exhibit booths. This will afford an opportunity to personally contact men who can be helpful in the solution of welding and heat-treating problems.

Exhibits of Interest to Welding Men

Acme Electric Welding Co., Huntington Park, Calif. (Booth B-32)

See Resistance Welder Manufacturer's Association.

Air Reduction Sales Co., New York, N. Y. (Booth G-20)

EXHIBITING: The Air Reduction exhibit will feature demonstrations of flame cutting on the new No. 10 Planograph as well as actual work being performed on both the No. 4 and the No. 10 Radiagraphs. Equipment for Airco flame cleaning and dehydrating, for plate edge preparation and manual grooving, will also be displayed. Bronze welding using rods coated with a non-flaking flux, which is either applied right on the job in liquid form or as a factory coating, will be demonstrated. These coated Airco bronze rods insure the operator of strong, sound welds.

IN ATTENDANCE: C. D. W. GIBSON, J. J. CROWE, G. V. SLOTTMAN, E. V. DAVID, R. F. HELMKAMP, A. H. YOCH, V. FORGETT, J. MCGRATH, A. N. KUGLER, H. W. READE, G. VAN ALSTYNE, J. F. CALLAHAN, H. F. HENRIQUES, J. J. LINCOLN.

Allegheny Ludlum Steel Corp., Brackenridge, Pa. (Booth A-1)

Allis-Chalmers Mfg. Co., Milwaukee, Wis. (Booth Z-231)

EXHIBITING: One of the most interesting exhibits will be an operating unit of Allis-Chalmers new Weld-O-Tron low current electronic arc welder which uses currents as low as 5 amperes and $\frac{1}{32}$-in. and $\frac{1}{64}$-in. electrodes. The company will demonstrate what this versatile machine can do in the way of fabricating 18-8 and other thin stainless alloys.

American Brass Co., New York, N. Y. (Booth E-22)

EXHIBITING: Two welding booths for demonstrations of acetylene and electric arc welding with Anaconda Copper Alloy Welding Rods will be the feature of the American Brass Co. Exhibit. Emphasis will be given to welding with the new Anaconda 997 (low fuming) rod. Other rods used for demonstrations will include Tobin Bronze and Everdur.

IN ATTENDANCE: Representatives attending will include: C. M. LITTLE, manager, Buffalo Branch; T. S. FOOTE, dis-

trict manager, Cleveland; A. J. BAKER, agent, Cleveland; W. B. SAWYER, manager, Cleveland; E. B. BROWN, MARTIN BRANDTBERG.

American Gas Association, New York, N. Y. (Industrial Gas Exhibit)

American Institute of Mining and Metallurgical Engineers, New York. (Booth Y-18)

EXHIBITING: The role of minerals and mineral products in the world of today; geographical distribution of mineral resources of the world; technical literature as among "New Aids to Production."

American Machinist, New York. (Booth Z-232)

EXHIBITING: Magazines, books and technical articles of interest to metal-working production men. Part of the space will feature a display of Product Engineering which will be of a similar nature.

American Rolling Mill Co., Middletown, Ohio. (Booth E-16)

American Welding Society, New York. (Booth Y-44)

EXHIBITING: Literature and services of the various activities of the Society.

IN ATTENDANCE: A. F. DAVIS, chairman, membership committee; J. R. MORRILL; J. CARBIS; A. E. MARKEE; and J. T. WOLFENDUM.

Ampco Metal, Inc., Milwaukee, Wis. (Booth Y-26)

EXHIBITING: "Ampco-Weld" weldrod and Ampco Metal welding jaws ordies will be exhibited for the interest of those concerned with welding problems. "Ampco-Weld" is the new aluminum bronze rod produced by Ampco Metal, Inc. This weldrod is now being produced in six grades corresponding to the six grades of Ampco Metal. Three sizes, 1/8 in., 5/32 in. and 1/4 in. are available, with three coatings, light, medium and heavy, as the work may require.

Arcos Corp., Philadelphia. (Booth C-27)

EXHIBITING (in operation): A novel moving display showing the quality of stainless weld metal obtained from Arcos electrodes also stainless steel products fabricated by arc welding.

IN ATTENDANCE: R. D. THOMAS, president; H. N. EWERTZ, sales manager; R. D. THOMAS, JR., metallurgical engineer; K. W. OSTROM, welding technician; and R. E. CARRIAT, secretary.

Babcock & Wilcox Co., New York. (Booth Y-54)

Baldwin-Southwark Corp., Philadelphia, Pa. (Booth B-27)

Bastian-Blessing Co., Chicago. (Booth F-9)

Bethlehem Steel Co., Bethlehem, Pa. (Booth A-22)

Bridgeport Brass Co., Bridgeport, Conn. (Booth Y-27)

EXHIBITING: Brass and copper mill products such as sheet, rod, wire, seamless tubing, welding rod, condenser tubing, copper water tubing, brass pipe and Duronze alloys. A photo-mural of Bridgeport's new rolling mill.

Carborundum Co., Niagara Falls, N. Y. (Booth E-32)

EXHIBITING: Diversified display of abrasive materials, such as crank shaft wheels, snagging wheels, cut-off wheels, tool room wheels, diamond wheels, disc wheels, roll grinding wheels, mounted points, Aloxite cloth, polishing grain.

Carnegie-Illinois Steel Co., Pittsburgh, Pa. (Booth Z-104)

Carpenter Steel Co., Reading, Pa. (Booth E-27)

Chase Brass & Copper Co., Waterbury, Conn. (Booth C-21)

EXHIBITING (in operation): Demonstrations of welding bronze, copper and steel with Chase Welding Rods with all types of difficult welds, such as, butt, fillet, and lap will be featured.

IN ATTENDANCE: W. E. EVANS, sales promotion manager; F. A. MCNEILLY, J. J. VREELAND, JOHN BABIN, F. A. GALLO, M. L. WOOD, H. L. BURGHOFF, R. A. STERNTHALL, ROBERT LEA, and A. E. MOREDOCK.

The Clark Controller Co., Cleveland, Ohio. (Booth E-28)

EXHIBITING (in operation): Clark kickless cable for portable welder guns

Compressed Industrial Gases, Inc., Chicago. (Booth G-40, G-42, H-40)

Copperweld Steel Co., Warren, Ohio. (Booth F-20)

Dow Chemical Co., Midland, Mich. (Booth Y-58)

Eisler Engineering Co., Newark, N. J. (Booth D-29)

IN ATTENDANCE: CHARLES EISLER, president, and CHARLES EISLER, JR., engineer.

Electric Controller & Mfg. Co., Cleveland. (Booth B-29)

EXHIBITING (in operation): A complete line of welder contactors including the new type LWZ contactors used for larger ratings. Also operating a series of lights indicating the various functions will be an EC&M automatic-repeat, type 3-B weld timer and an EC&M Neotrol weld timer.

Electro Metallurgical Co., New York, N. Y. (Booth D-14)

Expert Welder Co., Detroit. (Booth B-32)

Federal Machine & Welder Co., Warren, Ohio. (Booth D-34)

Firth-Sterling Steel Co., McKeesport, Pa. (Booth X-11)

General Electric Co., Schenectady, N. Y. (Booth A-11)

EXHIBITING: A 300-ampere d-c welder, a newly-designed 200-ampere d-c welder, a 100-ampere a-c welding transformer, and the new 30-ampere a-c welding transformer with built-in high power factor. There will be a complete line of G-E welding electrodes on exhibit, as well as a welding demonstration booth for demonstrating the practical use of electrodes.

General Electric X-Ray Corp., Chicago. (Booth A-11)

Harnischfeger Corp., Milwaukee, Wis. (Booth E-20)

EXHIBITING (in operation): A battery of the new P&H WE and WA Model welders of square frame design.

Hooked up for operation from a centralized welding booth, such features of these units as single current control . . . single and multiple operation . . . and high frequency welding will be featured.

Smootharc welding electrodes, manufactured by this company, among which there will appear many new electrodes just recently introduced, developed especially for welding high tensile alloy steels, as well as rods used for hard surfacing will be displayed.

IN ATTENDANCE: M. H. RUTISHAUSER, sales manager, welder and rod division; G. L. DRAKE, sales manager, hoist division; B. PRATTE, sales engineer, hoist and crane division; F. A. WILCH, sales representative, welder hoist and crane division; A. A. MEYERS, assistant advertising manager; and F. J. HIRNER, sales engineer, welder and rod division.

Harris Calorific Co., Cleveland. (Booth Z-202)

EXHIBITING (in operation): The "Electric Master Mind" as developed by Robert E. Kinkead studies the time and quality of the work being produced by an arc welding operator, producing an accurate study of operator's performance and efficiency and improves the quality of arc welding.

Haynes Stellite Co., Kokomo, Ind. (Booth D-14)

EXHIBITING: A life-sized photographic model of a giant valve used on high-pressure, high-temperature steam installations, with an actual operating gate valve inserted in a cutaway section of the photograph, will demonstrate the uses of Haynes Stellite materials in valves of this type.

IN ATTENDANCE: A. B. CLARK, R. L. LERCH, E. E. LEVAN, G. F. REESE, F. P. SHEPHARD, and V. G. ULLMER.

Hobart Brothers Co., Troy, Ohio. (Booth C-28)

EXHIBITING: A complete line of improved Multi-Range Arc Welders. The full line of latest model welders including electric drive, gasoline engine drive and "Build Your Own" generators will be shown—in addition to Hobart's new AC 20-200 ampere welder for single phase power lines. The new Hobart "Streamliner" Jr., Gasoline Engine driven arc welder will be of special interest.

Hollup Corp., Chicago. (Booth H-40)

Industrial Publishing Co., Cleveland. (Booth F-36)

EXHIBITING: Descriptions and illustrations of advances in the use of welding in fabrication, production, and repair.

IN ATTENDANCE: I. B. HEXTER, president; and L. P. AURBACH, vice-president.

Iron Age, New York. (Booth Y-23)

EXHIBITING: Current copies of The Iron Age.

Lincoln Electric Co., Cleveland. (Booth B-10)

EXHIBITING (in operation): Latest developments in arc welding equipment, electrodes and accessories. A new engine-driven unit the ("Shield-Arc Jr.") which is exceptional in light weight, small size and low cost for its capacity. It is of 200 ampere capacity and is available with pneumatic-tired or steel-wheeled running gear. Its range of application includes welding of all ferrous and nonferrous metals.

IN ATTENDANCE: J. F. LINCOLN, president; C. J. LINCOLN, chairman board of directors; A. F. DAVIS, vice-president; C. M. TAYLOR, vice-president; W. S. STEWART, Cleveland district manager; G. LANDIS, chief engineer; E. W. P. SMITH, consulting engineer; J. R. MORRILL, F. W. KESSLER, J. S. MCKEIGHAN, G. A. SOHL, sales engineers; ARTHUR MADSON, head instructor, Lincoln School of Welding.

Linde Air Products Co., The, New York, N. Y. (Booth D-14)

EXHIBITING: A review of latest developments in the oxy-acetylene process and "Unionmelt" welding. Among equipment featured will be a new oxy-acetylene bar-cutting machine especially adapted to a multiplicity of steel mill cut-off operations.

Supplementing these demonstrations of oxy-acetylene machine-cutting will be an extensive display of stationary, semi-portable, and portable cutting machines. Featured among these will be a new light-weight, portable cutting machine for straight-lint, circle-, and simple shape-cutting. A representative line of Oxweld, Prest-O-Weld, and Purox oxy-acetylene welding and cutting equipment, and Prest-O-Lite air-acetylene equipment will be shown.

IN ATTENDANCE: J. W. BERGAN, C. E. BLAND, W. B. BROWNING, A. W. DAVIS, H. H. DYAR, J. A. FARRELL, P. B. FOSTER, G. L. GEISLER, J. HEMERLEIN, M. W. HIPPE, F. Z. HIPPLER, L. E. HUGHES, W. S. LEAPER, E. W. LEGLER, C. B. LYNN, J. F. MACFARLANE, A A. MARKEE, P. S. MOLONEY, E. D. MORRIS, B. C. OLSON, E. E. RADCLIFFE, J. A. REA, H. D. REEHL, G. F. REISS, B. J. RICHARDS, J. T. SAITER, JR., L. R. SCHULKINS, P. C. SLOANE, E. J. STARK, H. R. SULLIVAN, C. A. WEST.

Machinery, New York. (Booth E-7)

EXHIBITING: Trade papers and engineering books.

Macklin Co., Jackson, Mich. (Booth X-9)

Magnaflux Corp., New York. (Booth C-22)

P. R. Mallory & Co., Inc., Indianapolis, Ind. (Booth Z-119)

Maurath, Inc., Cleveland, Ohio. (Booth Z-102)

McKay Co., Pittsburgh. (Booth F-24)

EXHIBITING (in operation): The McKay Shielded-Arc welding electrode line.

Metal & Thermit Corp., New York. (Booth D-3)

EXHIBITING (in operation): The complete line of Murex electrodes for electric arc welding. A typical crankshaft repair made by Thermit welding and the M & T line of metals and alloys.

Multi-Hydromatic Welding & Mfg. Co., Detroit. (Booth B-32)

National Carbide Corp., New York, N. Y. (Booth G-20)

EXHIBITING: A display of National Carbide in the famous Red Drum will feature the exhibit of National Carbide Corp.

IN ATTENDANCE: E. C. ACKERMAN and B. N. GILMORE.

National Carbon Co., Inc., New York, N. Y. (Booth D-14)

National Cylinder Gas Co., Chicago. (Booth G-40, G-42, H-40)

National Electric Welding Machines Co., Bay City, Mich. (Booth C-30)

IN ATTENDANCE: E. C. SMITH, president; J. R. BRUECKNER, vice-president; C. E. SHEARER, secretary-treasurer - sales manager; and W. O. LITTLE, Cleveland district representative.

Norton Co., Worcester, Mass. (Booth A-9)

Page Steel & Wire Div., American Chain & Cable Co., Inc., Monessen, Pa. (Booth G-4)

EXHIBITING: Page gas and electric welding wires and Page shaped wires.

Progressive Welder Co., Detroit. (Booth D-30)

Ransome Concrete Machinery Co., Dunellen, N. J. (Booth E-12)

Resistance Welders Mfg. Assoc., Philadelphia. (Booth B-32)

Riehle Testing Machine Div., American Machine and Metals, Inc., East Moline, Illinois. (Booth Y-22)

John A. Roebling's Sons Co., Trenton, N. J. (Booth F-2)

Ruemelin Mfg. Co., Milwaukee. (Booth F7-A)

IN ATTENDANCE: H. A. FLITZ, sales manager.

Sciaky Corporation, Chicago. (Booth A-34)

S-M-S Corporation, Detroit. (Booth B-32)

Stoody Co., Whittier, Calif. (Booth D-32)

EXHIBITING: Will demonstrate the application of various Stoody hard-facing rods (by both electric and acetylene methods) to industrial equipment.

IN ATTENDANCE: GEORGE F. STALEY, Advertising Manager.

Swift Electric Welder Co., Detroit. (Booth B-32)

Taylor-Hall Welding Corp., Worcester, Mass. (Booth B-37)

IN ATTENDANCE: PRESTON M. HALL, president.

Taylor-Winfield Corp., Warren, Ohio. (Booth B-36)

Thomson-Gibb Electric Welding Co., Lynn, Mass. (Booth B-32)

Tinius Olsen Testing Machine Co., Philadelphia. (Booth C-15)

Una Welding, Inc., Cleveland. (Booth X-15)

EXHIBITING: The Una-matic tractor carriage unit. Manual welding rods with description. The semi-automatic Goodspeed head and the Una-matic all-electric type electric head with taper attachment.

Union Carbide & Carbon Corp., New York (Booth D-14)

United States Steel Corp., Pittsburgh. (Booth Z-104)

Cooperating in this joint exhibit will be the following subsidiaries: American Steel & Wire Co., Carnegie-Illinois Steel Corp., Columbia Steel Co., Cyclone Fence Co., Scully Steel Products Co., and Tennessee Coal, Iron & Railroad Co.

Wall-Colmonoy Corp., Detroit. (Booth Y-39)

Welding Engineer Publishing Co., Chicago. (Booth Y-48)

EXHIBITING: The Welding Engineer, pioneer business and technical journal of the welding industry. The Welding Encyclopedia, a complete text on all aspects of welding the various weldable metals. Written for the engineer, designer, metallurgist and welding technician. The Oxy-Acetylene Welders' Handbook, a fundamental treatise on modern oxy-acetylene practice for the beginner and advanced operator.

IN ATTENDANCE: G. H. MACKENZIE, publisher; T. B. JEFFERSON, editor; M. S. HENDRICKS, promotion manager; T. E. DEPEW, eastern representative.

Welding Engineering Co., Milwaukee, Wis. (Booth I-4)

Welding Machines Manufacturing Co., Detroit. (Booth C-33)

Welding Sales & Engineering Co., Detroit. (Booth B-32)

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. (Booth B-22)

Wilson Welder Metals Co., Inc., North Bergen, N. J. (Booth G-20)

Wire Association (Booth F-32)

EXHIBITING: An attractive display and demonstration of the Wilson "Hornet" and "Wasp" electric welding machines will feature the exhibit of the Wilson Welder & Metals Co., Inc., at the National Metal Exposition in Cleveland's Public Auditorium, October 21-25.

IN ATTENDANCE: I. B. YATES, P. M. MATTERN, S. S. ADELSON, G. H. SANDBERG, W. H. DUETTING, S. H. NEWBURN.

The Youngstown Sheet and Tube Company, Youngstown, Ohio. (Booth F-18)

How Much Metal in a Fillet Weld?

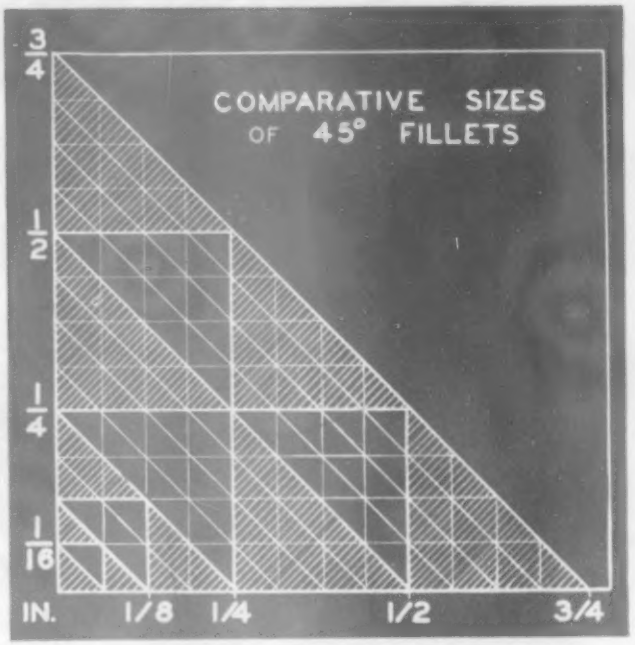


Figure 1 — Aided by this chart the cross-sectional area of various size 45 degree weld fillets may be compared readily.

Every day, without realization, many of us associated with the welding industry — engineers, designers, inspectors and welders — through thoughtlessness, are increasing the cost of fabrication.

In the case of the fillet weld, for example, an engineer will calculate the amount of welding required to develop full strength in a particular joint. After making these determinations, the size of the fillet is often increased because as calculated it appears to be too small. This policy of increasing the joint size is sometimes good practice. Occasionally, the calculated fillet is so small, the layman is inclined to doubt its strength and ability to stand up during the expected life of the pieces joined by welding.

If the fillet size could rest after the engineer has made his selection, everything would be fine but often this is not the case. Each time a new pair of eyes see the plans, the size of the fillet is changed. After having been "checked" by the designer, inspector, foreman and fabricated by the welder, that fillet which was calculated to be 3/16 in. in size has grown to a 3/8 in. fillet. A fillet weld that is much too strong and much too expensive!

While the size of the weld has only been doubled, there is actually four times as much weld metal in the deposit. Consequently the welding costs are at least four times as great as was necessary for the job.

The amount of weld metal required to deposit a fillet weld of a given size as compared to the amount required for a larger size fillet is given in Table 1. This Table covers fillets ranging in size from 1/8 to 1 inch and will amply equally as weld to 30-60 degree fillets as to the 45 degree fillets.

The cross-sectional areas of 45 degree fillets are compared in Figure 1.

In Table 2 is given data showing the amount of welding electrode required in pounds per foot of fillet weld. This Table is based on 70% efficiency in deposit, i.e., 70% of the weight of the rod is deposited while 30% is lost through rod ends, coating and splatter. Electrode losses vary — 30% is considered the average loss, while in cases it will be as low as 20% or as high as 50% depending on the size of the electrode, the welder, and other conditions.

It should be noted that the 30-60 degree fillet, which in many cases is considered more satisfactory than the 45 degree fillet, requires twice as much weld metal to deposit a fillet of the same height.—T. B. J.

TABLE 1—Filler Metal Ratios for Fillet Welds
(Large fillets as compared to small fillets)

Inch	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	Inch
1/8	1.00	2.25	4.00	6.25	9.00	16.00	25.00	36.00	64.00	1/8
3/16		1.00	1.77	2.77	4.00	7.11	11.11	16.00	28.40	3/16
1/4			1.00	1.56	2.25	4.00	6.25	9.00	16.00	1/4
5/16				1.00	1.44	2.56	4.00	5.76	10.24	5/16
3/8					1.00	1.77	2.77	4.00	7.11	3/8
1/2						1.00	1.56	2.25	4.00	1/2
5/8							1.00	1.44	2.25	5/8
3/4								1.00	1.77	3/4
1									1.00	1

TABLE 2—Weld Metal Requirements for Fillet Welds

Size of Fillet	45 Deg. Fillets		30-60 Deg. Fillets	
Inches	Lbs. of Metal Per Foot	Lbs. of Rod Per Foot	Lbs. of Metal Per Foot	Lbs. of Rod Per Foot
1/8	.027	.039	.054	.078
3/16	.063	.090	.126	.180
1/4	.106	.151	.212	.302
5/16	.166	.237	.332	.474
3/8	.239	.342	.478	.684
7/16	.325	.465	.650	.930
1/2	.425	.607	.850	1.214
5/8	.663	.948	1.226	1.896
3/4	.955	1.364	1.910	2.728
7/8	1.300	1.857	2.600	3.714
1	1.698	2.425	3.396	4.850

A *New* MATERIAL FOR FABRICATION AND REPAIR

BIG NEWS! Now famous AMPCO-METAL, the bronze without an equal, is obtainable in coated welding rods, trade-named AMPCO-WELD. Every conceivable kind of test has shown that these new type rods give startling results. They are more usable, more easily handled and stronger than any bronze rod available heretofore.

For over 26 years, American industry has turned to AMPCO-METAL to solve ***"Metal Failures"*** because of AMPCO'S exceptional wearing qualities, resistance to fatigue and corrosion. There just is no other bronze like it.

And now that AMPCO-WELD supplies the unequaled physical properties of AMPCO-METAL plus extreme weldability, many heretofore seemingly insurmountable fabrication and repair jobs can be easily "licked."

New bulletin is just off the press! It offers complete data on AMPCO-WELD rods in six grades, with detailed information on their application and use. Write for a copy at once.

Ampco Metal, Inc. Dept. WE-10 Milwaukee, Wis.

Stronger THAN STEEL

The actual photograph at left shows a standard .505" test bar turned of SAE 1020 steel with a "V"-notch weld of grade 18 "Ampco-Weld." This bar broke after 27% elongation in a 2" gauge length, at 84,000 lb. per square inch. The steel necked down to form a cup fracture. The "Ampco-Weld" (dark area) retains its original diameter. The steel draws away from the weld without breaking the bond.

AMPCO

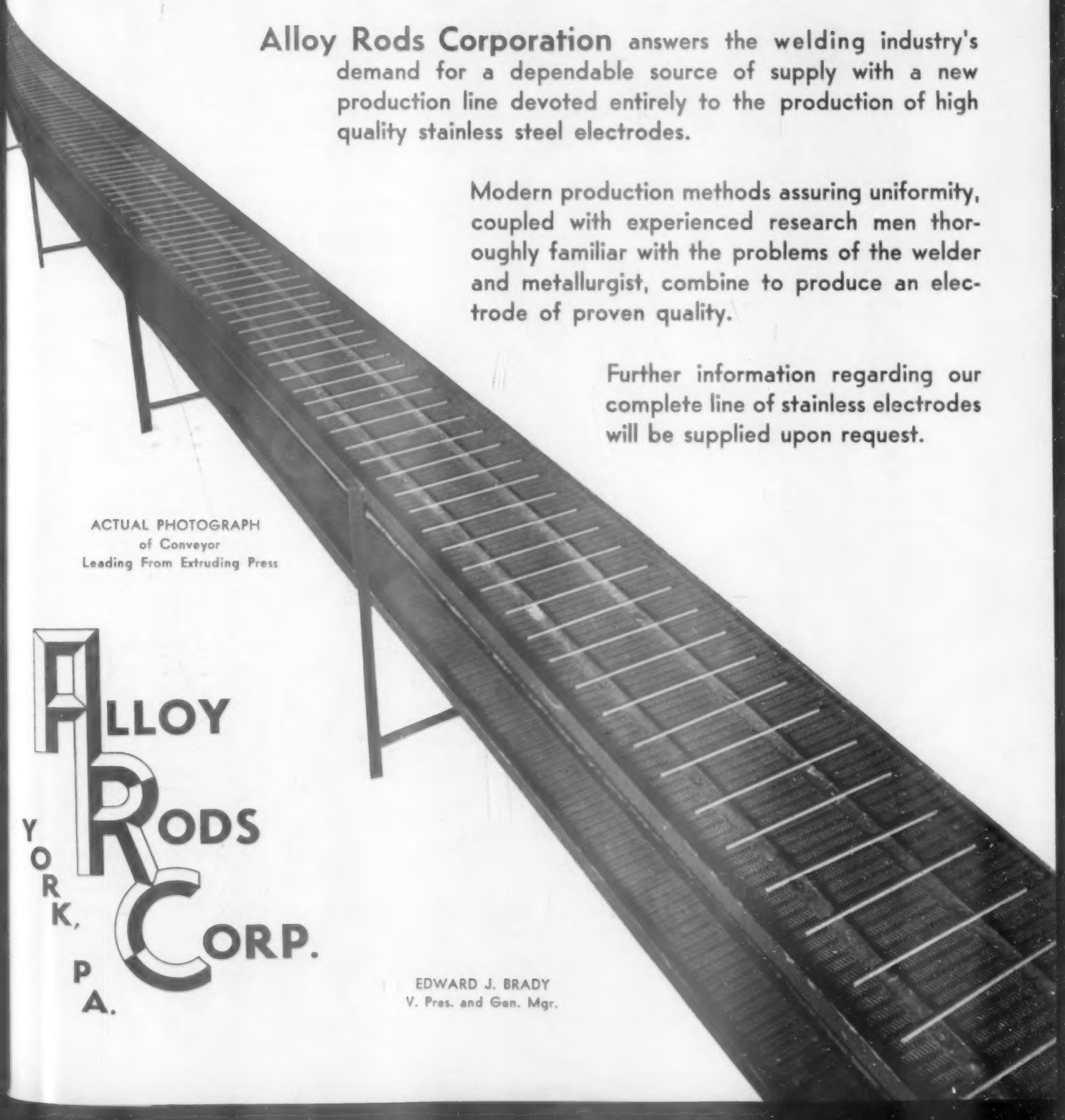
Announcing —

A NEW PRODUCTION LINE
TO SERVE
THE ALLOY WELDING INDUSTRY

Alloy Rods Corporation answers the welding industry's demand for a dependable source of supply with a new production line devoted entirely to the production of high quality stainless steel electrodes.

Modern production methods assuring uniformity, coupled with experienced research men thoroughly familiar with the problems of the welder and metallurgist, combine to produce an electrode of proven quality.

Further information regarding our complete line of stainless electrodes will be supplied upon request.



ACTUAL PHOTOGRAPH
of Conveyor
Leading From Extruding Press

ALLOY RODS CORP.
YORK, PA.

EDWARD J. BRADY
V. Pres. and Gen. Mgr.

THE TECHNICAL SLANT

"EDUCATION IS KNOWING THE ANSWER OR WHERE TO FIND IT"

Aviation

A B C OF AVIATION. REVISED EDITION. *By Lt. Col. Victor W. Page. Published by Norman W. Henley Publishing Co. New York, 1939. Cloth, 5 x 8 in., 418 pages. Price $2.50.*

Colonel Page's revised and enlarged edition of this book is a simplified account of aviation. It is written in a non-technical tone and is intended for the beginner in aviation. For those who desire to learn about aircraft, aircraft instruments and the aircraft industry without becoming too involved, technically.

The chapters of the book are devoted to the different types of aircraft, their design and construction, engines, propellers and instruments. There are also chapters on instrument flying and inspection. A B C of Aviation should prove to be a useful book for those wanting to learn some of the phases of aviation, particularly, those newcomers who are entering the aircraft industry in this period of industrial expansion.

» «

Blueprint Reading

SIMPLE BLUEPRINT READING with Special Reference to Welding. *Published by The Lincoln Electric Co., Cleveland, 1940. Simulated leather, 6 x 9 in., 138 pages, 164 illustrations. Price 50 cents in U.S.A., 75 cents elsewhere.*

In this book there is afforded a basis for the study of blueprint reading, which, together with practice in the actual reading of drawings, will guide the student to proficiency in this subject. While the book has apparently been compiled and published primarily for welders, it contains information of value for the student learning machine drawing or the draftsman or engineer who wishes to become familiar with welding symbols and welding drafting.

The use of welding symbols on drawings is carefully explained in subject matter and clarified by illustrations. In order that the beginner may be certain as to the meaning of the various symbols some of the drawings are supplemented by photographs of the finished article clearly showing the locations of the welds. There are many illustrations of practical examples of drawings of machines parts, pipe connections, general construction and similar objects of welded construction. It is believed that this book would have been more complete had the authors identified all of the drawings. Many of the drawings have captions so that a student will be able to tell the name of a particular piece but, unfortunately, there are some interesting and complicated pieces illustrated that he will never be able to identify.

Nevertheless, Simple Blueprint Reading, while not an exhaustive treatise on the subject of blueprint reading, affords a sound basis in the fundamentals and will prove valuable to those interested in welding.

» «

Personnel

TRAINING PROCEDURE. *By Frank Cushman. Published by John Wiley & Sons, Inc., New York, 1940. Cloth, 5 x 7½ in., 230 pages. Price $2.00.*

This book is especially timely with so many industrial organizations expanding their personnel. While the author limits his discussion to employed personnel, there is much practical information given regarding training instruction selection and training instructors and ways of checking the effectiveness of training programs.

The prime purpose of the book is to improve the character and performance of the work of the employee. To obtain improved performance the author reviews many of the problems that are encountered in the planning, organizing and carrying out of effective training programs in business, industrial and public service organizations. In addition, suggested outlines for a number of training courses are included in the appendix.

» «

Shop Practice

MACHINE SHOP WORK. REVISED EDITION. *By Frederick W. Turner and Oscar E. Perrigo, revised by Aldrick Bertrand. Published by American Technical Society, Chicago, 1940. Cloth, 6 x 9 in., 361 pages. Price $2.75.*

Modern Machine Shop is one of the most comprehensive books on approved machine shop practice that has ever come to the reviewer's attention. The text which seems quite complete is supplemented by numerous illustrations and diagrams of shop machines and production methods. Many of the diagrams illustrate production procedure suggestions.

Shop tools of every description, hand and machine, have been included. There are details as to the construction of tools and machines as well as pointers as to their efficient use. Modern production methods are discussed, also. A chapter has been devoted to air tools and another discusses the use of the slide rule.

Readers of the **Welding Engineer** may purchase the above books direct from the Welding Engineer Publishing Co., 506 So. Wabash Ave., Chicago, Ill. if they so desire.

The Story of Artificial Light

★ The story of artificial light, starting with the primitive torch, going on to the flickering kerosene lamp which the automobile first adapted from the horse-drawn carriage and leading up to the Sealed Beam Headlight, one of the very latest in the many efficient automotive developments, is told in **Optics and Wheels,** the most recent of a series of research-type booklets published by **General Motors.**

The Sealed Beam Headlight, introduced on 1940 automobile models as the result of a cooperative project undertaken jointly by the automobile industry, lamp manufacturers, motor vehicle commissioners and highway safety groups in the interest of safer night driving, had these seven major objectives:

(1) It must provide the safest possible seeing under all night-driving conditions, hence a two-beam system; (2) must provide relief from glare when meeting other cars, hence a passing beam; (3) must be easy to operate, hence a left foot switch for changing and an upper beam indicator; (4) must maintain its lighting efficiency; (5) must be simple to adjust; (6) must have simplified parts distribution to facilitate immediate replacement service; (7) must simplify work of officials responsible for laws and traffic regulations.

That all these requirements of good lighting are fulfilled is graphically demonstrated in Optics and Wheels, which not only recites the interesting history of lighting and discusses the intricate science of optics, but also stresses the human element upon which all safety precautions so largely depend. Those desiring to receive a copy of Optics and Wheels may do so, free, by addressing their request to the **General Motors Corp.,** Detroit, Mich.

» «

New 44-Page Booklet on Industrial Dermatitis

★ **"The Answer to Industrial Dermatitis"** is the title of a new 44-page booklet released by **The Milburn Company,** 905 Henry St., Detroit, Michigan.

It describes the various causes, and means of preventing and protection against industrial skin diseases and enumerates ten different kinds of creams and ointments for specific applications in various industries including one for use of welders for their protection during welding and cutting operations.

Included in the booklet, too, is a 20-page scientific study of skin structure and composition and the underlying principles of skin injury in relation to industrial dermatitis.

★ ALLOYS

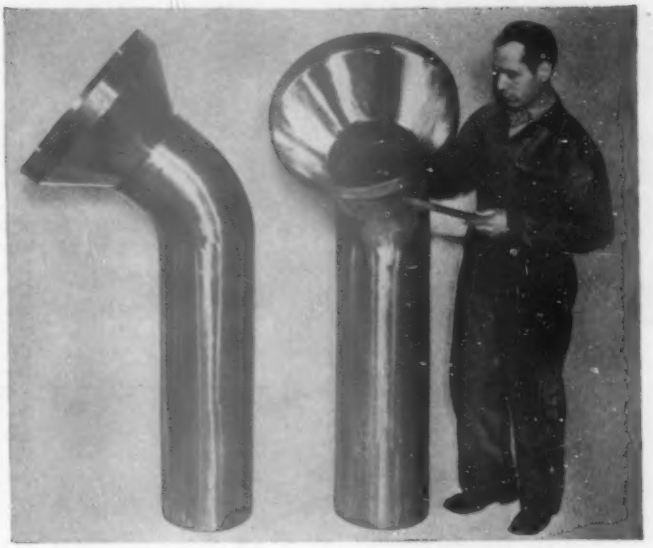


Fig. 12 — Electric arc welded and polished .062" thick Monel hoppers and chutes.

Further Data

on the Welding of

High Nickel-Bearing Alloys

★ Part 3* — Surface preparation is important in welding these metals, as is—Preheat, Electrode Manipulation, Jigs and Clamps.

ELECTRODES AND oxy-acetylene welding wires and fluxes for Monel, nickel and Inconel have been developed for use on clean metal, such as standard cold rolled sheet, pickled hot rolled plate, or cold drawn rod. To insure satisfactory welding of hot rolled plate, hot rolled bar stock, or material that has been hot worked otherwise in processing or fabrication, it is necessary, first, to remove the thin darkly colored oxide film from the immediate vicinity of the area to be welded. The oxide can be removed either mechanically by machining, sandblasting, grinding or rubbing with emery cloth, or chemically by pickling. A hot rolled plate that has been machine beveled in preparation for a butt joint needs no further cleaning because a clean metal surface is exposed on the face of the bevel. However, if an attachment must be made by fillet welding to the surface of a hot rolled plate not previously cleaned, the oxide must be removed, preferably by light grinding either with a disc, fine grit solid emery wheel, or rolled head wheel. If the oxide is not removed, difficulty, in the form of a wandering arc, may be encountered in welding.

The sand cast surfaces of Monel, nickel or Inconel castings must be removed from the areas to be welded by either rough grinding or machining.

Jigs and clamps, useful in the electric welding of Monel, nickel and Inconel, are described on page 68.

In general, preheat is neither required nor recommended for arc welding wrought Monel, nickel or Inconel, but if the metal temperature should drop to freezing or below, it is best to preheat the joint to 70° F. or over for 6 in. on both sides of the welding groove.

Simple castings of Monel, nickel or Inconel which are to be electric arc welded to equipment, need not be preheated, but a preheat of 200° to 300° F. is desirable for complicated castings.

Electrode Manipulation

The best electrode position for downhand welding is at an incline of about 20° from the vertical, ahead of the puddle as in column 10 of Table 10. This position is best suited to control of the molten flux and elimination of slag trapping. It is essential that a short arc be maintained.

*Part 2 was published in September 1940 issue pages 21-25.

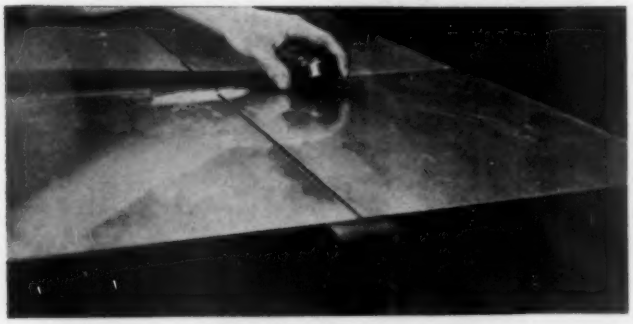


Fig. 13—(above) Welding Monel linings to galvanized steel angles. The lining, 14 gauge (.078 in.) Monel sheet, rests on 2 in. x 2 in. galvanized steel angles. The Monel sheets are set up for welding with a 3/16 in. gap between edges of butt joints. Grinding the galvanized coating off the angle before welding Monel is not necessary as galvanizing does not interfere with welding or the quality of the weld. (below) The welding is done using a 1/8 in. diameter No. 130X Monel arc welding rod, the weld penetrating into the angle. For this width bead weaving the electrode is a necessity.

For overhead welding, the only change necessary is a slight further shortening of the arc and lowering of the current strength by 5 to 15 amperes. The weld metal does not spread as in welding steel, but must be placed where required, which makes it necessary to weave the electrode slightly.

Vertical Welding

The instructions for overhead welding apply to vertical welding also, except that the amperage must be lowered 10 to 20 amperes from the normal flat welding heat. For metal .062 in. and .078 in., welding should be started at the top and progressed straight downward. On metal thicker than .078 in., welding can be carried on from the bottom upward or from the top downward. The electrode should be held approximately at right angles to the plate being welded.

When withdrawing an electrode for any purpose, the arc should be drawn away from the crater rather slowly. This provides the crater with a blanket of flame that protects it from oxidation while it is freezing.

A straight drag, or string bead laid down without weaving is used for single bead work, or in close quarters on thicker sections, as in the bottom of a deep groove. If a weave is necessary or desirable, it can be used.

Minimum properties obtainable in butt welded joints are given in Table 11; these may be used for design purposes in all gauges of sheet and plate. Tensile properties of electric arc welded joints in Monel, nickel and Inconel are listed in Tables 12 to 15 inclusive.

Table 11—Minimum Tensile Properties for Annealed Material and Welded Joints for Design

Metal	Minimum Tensile Strength of Electric Arc Welded Joints psi	Minimum Elongation in Free Bend per cent
Monel.....	70,000	30
Nickel.....	60,000	25
Inconel...	80,000	30

Bead widths range from 1/8 in. to 5/16 in. Wider, and usually flatter, beads are obtained by weaving, and range from 3/8 in. wide to a max-

Table 12—Rounded Average Tensile Properties of Welded Butt Joints in Monel made with No. 130X Monel Electrodes

Plate Thickness Inches	Type of Joint	Electrode Diameter Inches	Tensile Strength—psi: Full Section (Long Gauge) Flat	Vertical	Overhead	Reduced Section (Short Gauge) Flat	Value	Overhead	Minimum Elongation in Free Bend per cent
1/8	Square Butt	1/8	75,500	76,500	76,600	78,600	78,800	77,800	30
1/8	Single Vee	1/8	77,300	76,900	76,300	78,100	79,600	79,100	30
3/16	Single Vee	1/8	78,400	80,200	79,800	81,700	83,200	82,400	30
1/16*	Single Vee	1/8	77,200			79,800			30
1/4	Double Vee	1/8				84,400			30

*Stress relieved.
NOTE: All welds were machined flush with plate before testing.

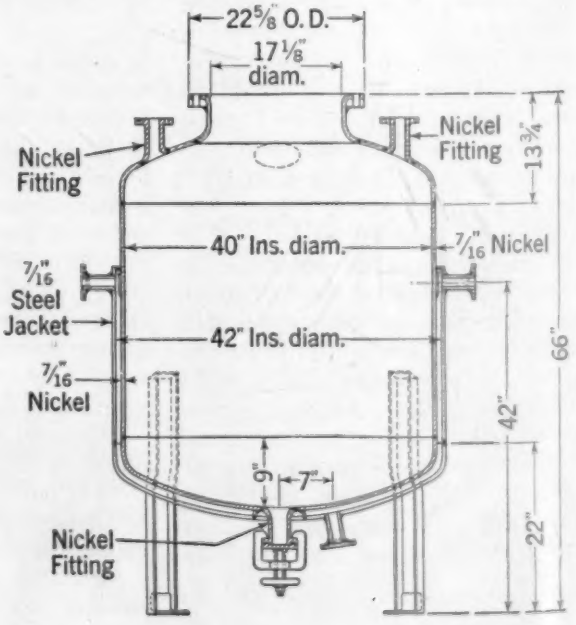


Fig. 14—Details of steel-jacketted nickel pressure vessel. The joint designs employed are typical of those used in process equipment.

Table 16—Electrode Requirements for Various Types of Welded Joints in Monel, Nickel and Inconel (Manual Welding)

Type of Joint	Sheet or Plate Thickness "T" inches	Width of Bead (or Groove) "W" inches	Root Spacing "S" inches	Average Amount of Metal Deposited per Lineal Foot: cu. in.	Average Amount of Metal Deposited per Lineal Foot: lb.	Approximate Weight of Electrode Required lb. per Lineal Foot (see Note 2)
SIMPLE BUTT (Reinforcement .03"-.06"; Removable Copper Backing)	.037	1/8	0	.07	.02	.025
	.050	5/32	0	.13	.04	.05
	.062	3/16	0	.13	.04	.06
	.093	3/16–1/4	0–1/32	.18	.06	.08
	.125	1/4	1/32–1/16	.22	.07	.09
SQUARE GROOVE (Reinforcement .03"-.07")	1/8	1/4	0–1/32	.35	.11	.15
	3/16	3/8	1/32–1/16	.74	.24	.32
	1/4	7/16	1/16–3/32	.97	.31	.42
"V" GROOVE (75°; Reinf. .04"-.08"; 1/16" Lip; Removable Copper Backing)	3/16	.30	1/8	.72	.227	.31
	1/4	.45	3/16	1.39	.443	.61
	5/16	.54	3/16	1.84	.582	.80
	3/8	.63	3/16	2.36	.745	1.02
	1/2	.90	3/16	3.68	1.16	1.59
	5/8	.97	3/16	5.10	1.61	2.21
"V" GROOVE (75°; Reinf. .04"-.08"; No Backing Used. Under Side of Weld Chipped and Welded)	1/4	.42	3/32	1.33	.42	.58
	5/16	.51	3/32	1.71	.54	.74
	3/8	.59	1/8	2.30	.73	1.00
	1/2	.84	1/8	3.85	1.21	1.67
	5/8	.91	1/8	4.63	1.46	2.00
"U" GROOVE (15°; Reinforcement .05"-.08"; See Note 1; 1/16" R.; 1/32" Lip)	1/2	.679	....	3.27	1.03	1.41
	5/8	.745	....	4.37	1.38	1.90
	3/4	.813	....	5.33	1.68	2.30
	1	.957	....	8.35	2.63	3.60
	1 1/4	1.073	....	11.48	3.62	4.96
	1 1/2	1.015	....	15.16	4.79	6.55
	1 3/4	1.349	....	18.90	5.98	8.19
	2	1.485	....	23.45	7.40	10.12
DOUBLE "U" GROOVE (15°; Reinf. .08"; 1/16" R.; 1/32" Lip; See Note 1)	1	.679	....	6.54	2.06	2.82
	1 1/4	.745	....	8.74	2.76	3.80
	1 1/2	.813	....	10.66	3.36	4.60
	2	.957	....	16.66	5.26	7.20
	2 1/2	1.073	....	22.96	7.24	9.92

Type of Joint	Sheet or Plate Thickness "T" inches	Width of Groove "W" inches	Size of Fillet "L" inches	Average Amount of Metal Deposited per Lineal Foot: cu. in.	Average Amount of Metal Deposited per Lineal Foot: lb.	Approximate Weight of Electrode Required lb. per Lineal Foot (see Note 2)
BEVEL GROOVE (Reinforcement .04"-.08"; 45°; 1/8" Lip; See Note 1)	1/4	.125	....	.22	.07	.09
	5/16	.188	....	.40	.13	.17
	3/8	.250	....	.61	.19	.26
	1/2	.375	....	1.21	.38	.52
	5/8	.500	....	1.98	.63	.86
	3/4	.625	....	2.95	.93	1.28
	1	.875	....	5.57	1.77	2.42
DOUBLE "J" GROOVE (Reinf. .04"-.08"; 15°; 1/8" Lip; 1/2" R.; See Note 1)	1	.500	....	4.67	1.48	2.0
	1 1/4	.563	....	6.90	1.90	2.6
	1 1/2	.594	....	8.10	2.56	3.5
	1 3/4	.625	....	9.83	3.11	4.3
	2	.656	....	12.06	3.81	5.2
	2 1/4	.688	....	14.29	4.51	6.2
	2 1/2	.750	....	16.68	5.27	7.2
DOUBLE BEVEL GROOVE (Reinf. .04"-.08"; 1/8" Lip; See Note 1; 45°)	1/2	.188	....	.78	.25	.34
	5/8	.250	....	1.24	.39	.54
	3/4	.313	....	1.78	.56	.77
	1	.438	....	3.13	.99	1.36
	1 1/4	.563	....	4.87	1.54	2.15
	1 1/2	.688	....	7.00	2.21	3.03
	1 3/4	.813	....	9.47	3.00	4.09
	2	.938	....	12.33	3.90	5.35
"J" GROOVE (Reinf. .04"-.08"; 15°; 1/2" R.; See Note 1; 1/8" Lip)	1	.625	....	5.64	1.78	2.4
	1 1/4	.719	....	7.91	2.50	3.4
	1 1/2	.781	....	10.20	3.23	4.4
	1 3/4	.875	....	12.95	4.09	5.6
	2	.969	....	15.60	4.93	6.8
	2 1/4	1.031	....	18.35	5.80	8.0
	2 1/2	1.094	....	21.95	6.94	9.5
CORNER FILLET	1/16	....	....	.05	.03	.04
	3/32	....	....	.09	.04	.05
	1/8	....	....	.15	.05	.07
	3/16	....	....	.33	.10	.14
	1/4	....	....	.59	.19	.26
	5/16	....	....	.92	.29	.40
	3/8	....	....	1.32	.42	.57
	1/2	....	....	2.35	.74	1.02
LAP	....	....	1/8	.09	.03	.04
	....	....	3/16	.22	.07	.10
	....	....	1/4	.38	.12	.16
	....	....	5/16	.59	.19	.26
	....	....	3/8	.84	.27	.37
	....	....	1/2	1.50	.47	.64
	....	....	5/8	2.34	.74	1.01
	....	....	3/4	3.38	1.07	1.46
	....	....	1	6.00	1.90	2.60
FILLET (L, L)						

NOTE 1—If underside of first bead is chipped out, and welded, add 0.21 lb. of metal deposited (equivalent to 0.29 lb. of electrode).
2—To find linear feet of weld per pound of electrode, take reciprocal of pounds per linear foot.

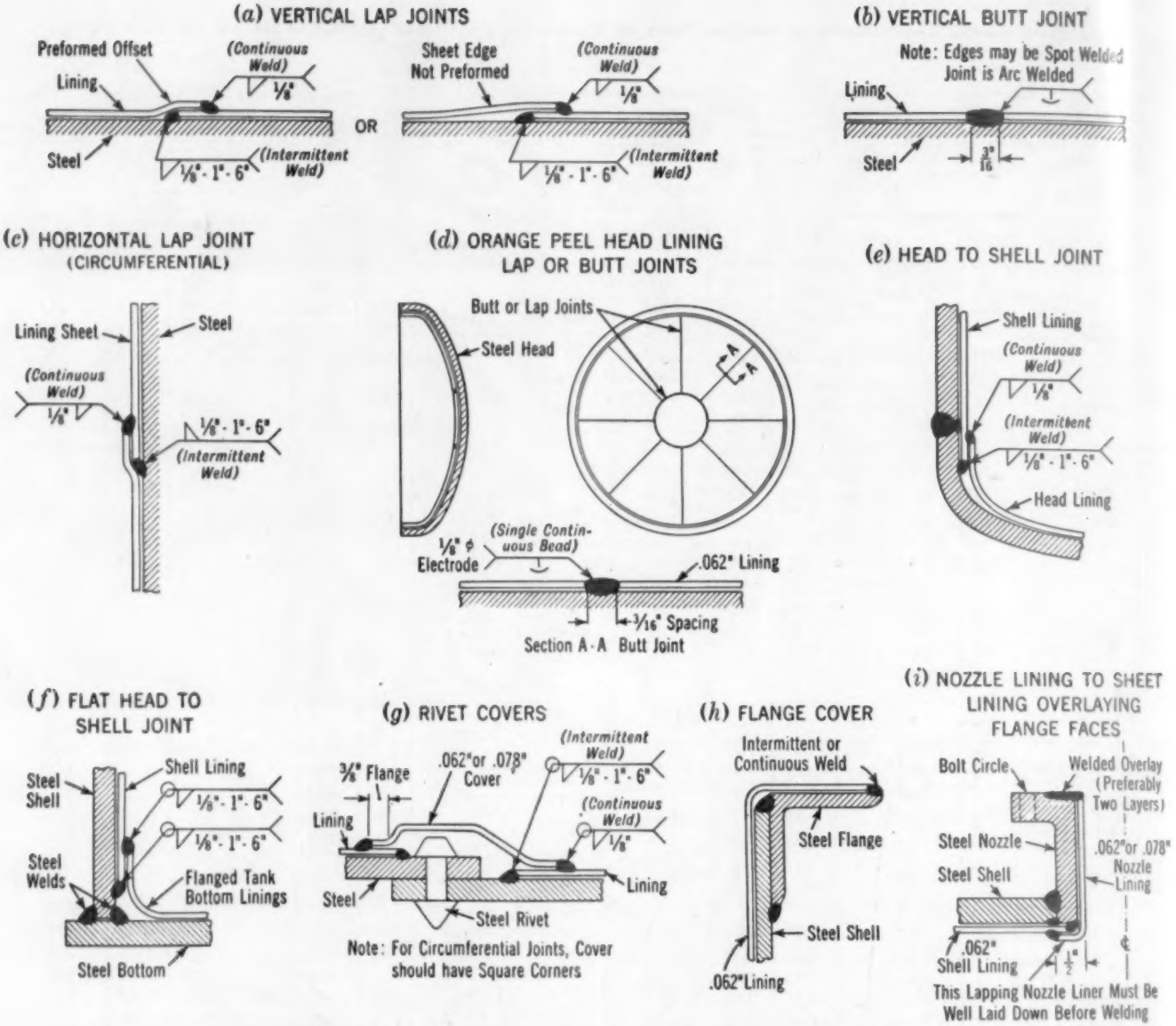


Fig. 15—Suggested joint designs for welded linings of Monel, nickel and Inconel in steel vessels and tanks.

imum of ¾ in. In general, wider beads should not be used even for overlaying as this requires excessive puddling of the molten pool of metal.

A 24 to 27 volt arc, usually referred to as a "short" arc, should be maintained during welding. For $\frac{3}{16}$ in. and ¼ in. diameter electrodes, a slightly higher arc voltage is necessary.

There should be no spatter during electric welding of the high nickel materials; its presence indicates excessive amperages or a long arc. Arc blow is not encountered during welding of Monel, nickel or Inconel.

The flux on arc welds is removed easily with hand tools, or a hand or powered wire brush. When making a multiple pass "U" groove joint it is very important that all flux or slag be removed before laying down each succeeding bead. A simple method is to lightly chip the edges of each bead with a $\frac{3}{16}$ in. or ¼ in. round nose gouge.

Beveling is not recommended for sheets of .140 in. (10 ga. U.S.S.)

Table 13—Hardness* Survey of Weld in ⅜ in. Monel Plate

Location of Test	As Welded	After Stress Relieving At 1150° F.
Center line of weld:		
Top	159	156
Center	159	165
Bottom	141	141
Junction of weld and base metal	159	154
Center of heat affected zone	153	153
Base metal remote from weld	144	144

*Readings taken as Rockwell and converted to Brinell. Published through the courtesy of the research department of M. W. Kellogg Company.

Table 14—Rounded Average Tensile Properties of Welded Butt Joints in Nickel made with No. 131 Nickel Electrodes

Plate Thickness Inches	Electrode Diameter Inches	Tensile Strength psi Full Section (Long Gauge)	Tensile Strength psi Reduced Sect'n (Short Gauge)
⅛	$\frac{3}{32}$	69,900	71,400
$\frac{3}{16}$	⅛	69,100	71,200
⅜	$\frac{5}{32}$	69,400	74,000

NOTE: All welds were machined flush with plate before testing.

Table 15—Rounded Average Tensile Properties of Welded Butt Joints in Inconel made with No. 132 Inconel Electrodes

Plate Thickness Inches	Electrode Diameter Inches	Tensile Strength psi Full Section (Long Gauge)	Tensile Strength psi Reduced Sect'n (Short Gauge)
⅛	$\frac{3}{32}$	95,700	106,200
⅜	$\frac{5}{32}$	92,400	93,700

NOTE: All welds were machined flush with plate before testing.

(*Continued on page 66*)

★ GENERAL

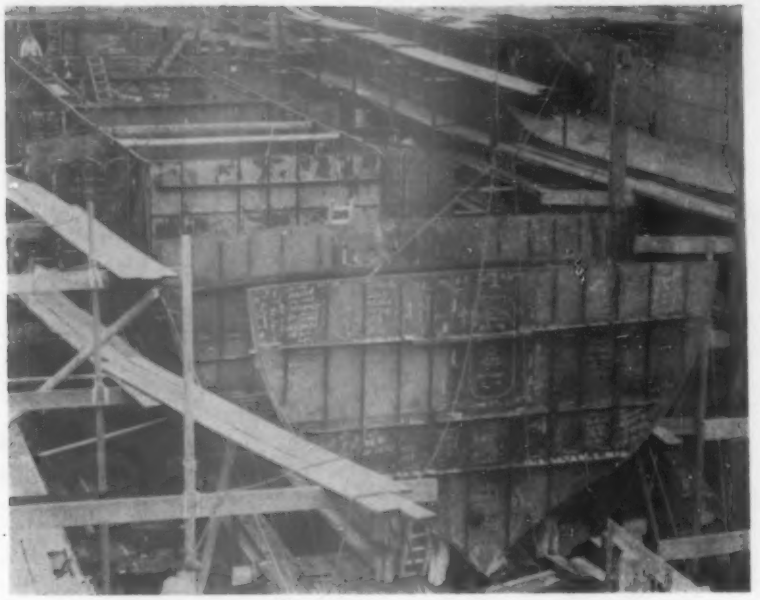


Fig. 1—The aft bulkheads of the H.M.S. Seagull.

English

Thoughts on

Welded Warships

★Welded construction and its advantages discussed. Interesting notes on the "Ark Royal," the "Hunter" and the "Graf Spee".

By E. DACRE LACY

London, England

THERE IS NO doubt that the reputed success of the German welded warships has been instrumental in stimulating Admiralties of other countries to see how far, with prudence, the arc welding system can be applied. Authentic and reliable accounts of the behaviours of the German welded warships during their main trials and in heavy seas have from time to time been reported and appear to have been satisfactory.

The British authorities have for years gone slowly and carefully ahead. In each and every ship laid down a large percentage of her structure is fabricated by arc welding. It can be safely said that, as far as this country is concerned, electric welding has now been applied for some years to the internal structures of warships, and has resulted in a definite saving in the hull weight.

The first class of warships to carry an appreciable amount of welding in the British Navy was the Country class of light cruisers. Since then, further progress has been made in the construction of the "Leander" class of light cruiser. These have a capacity of 7,000 tons carrying 6-in. guns, and most of the superstructure of these vessels is welded. H. M. S. "Arethusa," of the same class, was, as far as it is known, the first British warship to have her hull partially welded.

The "Ark Royal"

One of the greatest advances yet made in the practice of welding in warship construction was in the building of H.M.S. aircraft carrier "Ark Royal" at Birkenhead. This is reputed to be 75 per cent arc welded. She is one of the longest ships ever built at Birkenhead and, considering her size, the time she was on the stocks constituted a record, since her tonnage is 22,000 tons. This ship, which was designed by Admiralty con-

structors, is also remarkable in that she has the largest deck surface in the Royal Navy, and the decks are all welded. With respect to the battleships of the King George V Class, statements have been made to the effect that they are being partially constructed by electric arc welding. Details have also appeared in *The Welding Engineer** describing the construction of Britain's first entirely all welded warship H.M.S. "Seagull," one of two mine-sweepers recently built at Devonport Dockyard. Mr. A. Nicholls, R.C.N.C., Constructive Manager at H.M. Dockyard Devonport, in his very interesting paper which was read before the Institution of Naval Architects at their spring meeting, gave some very interesting information relating to the comparisons between H.M.S. "Seagull" and her riveted counterpart H.M.S. "Leda."

Proved Construction

In peace time it is naturally difficult to test welding which has been incorporated in the construction of a warship for service needs. The accident to H.M. Destroyer "Hunter" two years ago, when she struck a mine while on patrol work in the Mediterranean during the time of the Spanish Civil War, had at least the satisfactory outcome of demonstrating to the whole world the efficiency of British naval construction.

Numerous eminent naval architects and shipbuilders expressed the opinion at the time that had the whole ship been riveted she might have sunk as a result of the damage sustained. Likewise, all who commented on the detailed account given of the later examination of the vessel, expressed the admiration of the way in which the welding withstood the most severe buckling and stressing.

This accident proved beyond doubt the behaviors of welding under an explosive force, and up to the present time, this is perhaps the most searching of all test that welding has had to withstand. It should be particularly noted that the bulkheads were of thin mild steel and that the welding in many places withstood severe crumpling.

In view of this accident to H.M.S. "Hunter" it is understood that the authorities came to the unqualified conclusions that it would be well not to carry into welding technique the applications and methods to which shipbuilders had become accustomed in general riveted structures.

From the foregoing, it will be seen that until comparatively recently as far as the British Navy is concerned, electric arc welding has been used only for what is known as "non-strength work." The reason for this is that for work of this character the practice is to use steel comparable with mild steel of 60,000-65,000 lbs. tensile strength, which forms the bulk of the material used in the construction of merchant ships. This steel is very easily welded with the proper electrodes and undoubtedly the Admiralty as well as private ship-builders are in agreement with such practice.

Mr. E. F. Spanner, R.C.N.C. (Ret). M. Inst. N. A., M. I. Mar. E., writing on "Some Advantages of Electric Welding in Warship Construction," stated that it is when one comes to consider what electric welding has to offer for real strength work, i.e. construction of the hulls and strength decks of warships that one is tempted to question whether the modern warship is being as efficiently designed as she might be if departure were made from some of the principles which have become accepted practice for warship design.

Advantages of Welding

The advantages of electric welding for the hulls of warships must include the highly important fact that this process permits hull plates to be joined together without riddling them with holes. It also allows the large areas of the hull plating below and above water to withstand disruptive stress without springing leaks, ripping or twisting into fantastic shapes.

The adoption of electric welding for the part of the hull below water, owing to the absence of rivet holes, makes it possible for a great deal of the energy of the explosion to be dissipated in deformation of the bottom structure without actual puncturing of the hull necessarily following.

However, since Mr. Spanner put forward his suggestions regarding the advantage of welded hulls, the Admiralty have built as mentioned earlier in this article, the minesweeper, "Seagull" constructed almost entirely on the lines advocated by Mr. Spanner.

In view of the requirements of warship construction in times of war, it is not improbable that before very long we shall see the construction of larger warships which may be entirely welded. In times like the present, speed in the production of all ships is a very important factor, and if welding in shipbuilding rapidly developed during the last war, we may now expect some far-reaching extensions of the process.

Versailles Limitations

Previous to the first world war electric welding had only reached the experimental stage in shipbuilding. It was, however, during this war that electric arc welding came into its own mainly as a repair tool. After that war, owing to certain limitations laid down by the Treaties of Versailles and Washington, naval designers in the principal countries were set the task of designing an efficient fighting vessel, whose capacity did not exceed 10,000 tons.

Under the Treaty of Versailles, no German armored ship was to be larger than 10,000 tons, and no cruiser was to exceed 6,000 tons.

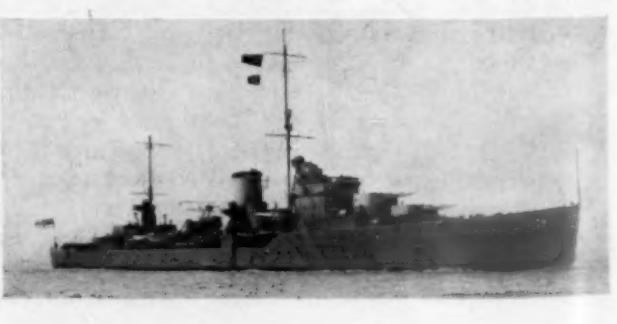


Figure 2—The H.M.S. Hunter proved the worth of welded construction.

*War Time Activities of British Welding Industry by John S. Trevor, Welding Engineer, May 1940, pages 23-26.

Figure 3—The H.M.S. "Seagull", Britain's first all welded warship.

This meant corresponding limitations in the size and range of armament and the powers of ships. Thus lightness became the essential requirement in the construction of German warships. By the increasing use of welding it was confidently believed that warships could obtain greater fighting value, higher speed and more space for using their personnel.

According to Obermarinebauret Burkhardt in "Die Elektroschweissung," the occupation of the Ruhr basin was the indirect cause of the application of electric welding to German warships.

German Construction

The construction of the first new German cruiser "Emden" was almost brought to a standstill owing to the fact that Z-rolled sections such as channels would have led to excessive weight. It was, therefore, decided to try out unequal angle sections, the long leg being welded to the plates. This led to considerable saving in weight, and every endeavor has since been made to adopt the new process of welding not as a substitute but as a general method in the construction of warships as a whole.

Weight Saving

The saving in weight for some of the many parts amounted to 20 per cent; for the whole ship 8 to 10 per cent; therefore, for a 6,000 ton cruiser, the saving in weight would be 200 to 300 tons. To take full advantage of such a saving in weight which could be used for other purposes — armaments, protection and speed — it was necessary to overcome the difficulties of rapid development. Thus, many difficulties were encountered at first but much experience was gained during the constructions of the ships. It was particularly of importance to discard traditional riveting methods of constructions.

Between 1927 and 1930 welding was used on the cruiser "Leipzig" and on a number of auxiliary vessels, however, the greatest interest was aroused in the construction of the armored cruiser "Deutschland" which is commonly known as the "pocket battleship." In the construction of this vessel it was claimed that at least 550 tons had been saved in weight by substituting welding for riveting.

In 1931 a second armored cruiser the "Ersatz Lothringen' was laid down. In this vessel all the joints of the main longitudinal framings of the superstructure were welded.

Other parts constructed by welding in German warships include the foreplate and frame of a torpedo boat. By adopting this process the designers were able to incorporate the longitudinal frame system in the construction of this type of vessel, which had been impossible when riveting was used. In cruiser bulkheads, the greatest saving in weight, through using fish-bellied stiffening beams, was obtained. Flanged joints were incorporated where the joint is used for stiffening thinner bulkhead sheets.

The "Graf Spee"

It is the opinion of acknowledged naval experts that "on paper" the "Graf Spee" was a unique vessel. Her defeat was brought about solely by the superior strategy of Admiral Harwood and the accuracy of the British gun fire. In theory she should have accounted for the three British light cruisers since they possessed not only guns of less calibre than the "Admiral Graf Spee" but a smaller range of fire. Undoubtedly welding had nothing to do with the defeat of the German ship. On the other hand, had she been riveted it is probable that she would have suffered much heavier damage.

Professor Wm. Hovgaard in a paper entitled: "The Relationship between armaments and protection in the 10,000 ton cruisers and the 'Ersatz-Preussen'" read before the Institution of Naval Architects stated that the German Minister of Defence had officially announced that by improved methods of design and construction a saving in hull weight of 550 tons had been effected in the construction of the "Ersatz Preussen."

This saving presumably refers to a comparison with earlier German ships, and is stated to have been obtained by an extensive application of welding and special high grade steels.

The effect of the construction of Germany's welded vessels on the navies of other countries may be summarized in the words of Sir George Thurston K.B.E., M.I.N.A., M.I.C.E.

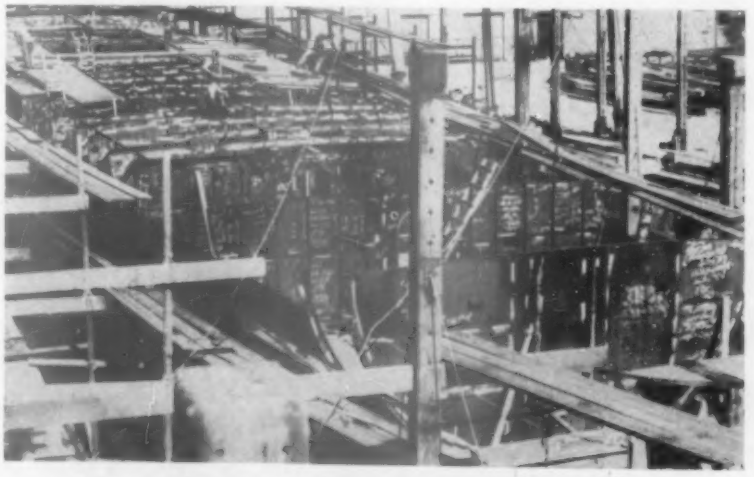


Figure 4—A general view of the upper deck of the "Seagull" during construction.

"Electric arc welding as applied to shipbuilding was brought more prominently to the front by the construction of the German pocket battleships 'Deutschland,' 'Admiral Scheer' and 'Admiral Graf Spee,' vessels of 10,000 tons displacement, with a length on the waterline of 590 ft. armed with six 11-in. and an auxiliary armament of eight 5.9 in. guns.

"It is generally assumed that the whole construction is based on electric welding in lieu of riveting, by which means a considerable weight-saving has been effected. If this information is correct then we have indeed reached a stage where we are justified in applying the system not only to the internal work of a vessel such as bulkheads, deck-plating, longitudinals, floors, stringers, etc. but to the shell itself, for although the principal has, we know, been applied to tankers, yachts, and similar craft, nothing to my knowledge has approached or can be compared to the achievement in this direction in German naval construction, due entirely to the courage of German naval designers and engineers, in adopting the welded method of connecting together the various parts of the hull structure of important ships of war.

"In the first place the German warships have a much greater length than other completely welded vessels with the depth amidships is comparatively small, so that the mounting of triple 11 in. guns forward and aft would go far to show up any weaknesses in the hull structure when riding rough seas in such as these vessels have undoubtedly been tried out. Couple with the repeated tests salvoes from both 11 in. turrets simultaneously, which with the known German character for thoroughness we can rely that tests have been thoroughly carried out to the evident satisfaction of the designers and to those upon whom rested the responsibility for giving the orders for their construction."

There is a certain amount of reticence regarding the application of welding in other foreign navies such as France, Italy and Japan. It should, however, be noted that electric arc welding has been applied for some years in the construction of the cruiser "Dupleix."

The saving in weight effected by welding in the construction of this ship amounted to about 100 tons. It may be found that this saving is rather slight compared with the figures announced by the Germans and the Americans. In order to find comparable basis, it must, however, be borne in mind that American cruisers were at that time being built with plates of 40 kilos. Owing to this fact the saving in weight obtained by the use of welding was larger than with any vessel built of plates of higher tensile strength and consequently lighter weight.

Japanese Construction

Very little has been published in Britain relating to electric welding carried out in the dockyards of the Imperial Japanese Navy. However, it is known that the first ship in which welding had been extensively used was the minelayer, called "Yaeyama." In the construction of this vessel horizontal welding was the general rule, vertical welding being used only when absolutely necessary. There was no overhead welding whatsoever.

The various parts of the ship were assembled on the ground and then welded and carried to the ship. The range of the welding was limited to the forepart and after part and half lengths at midships. Apparently the only reason that the vessel was not entirely constructed by welding was the fact of putting a number of riveters out of work. In the first instance, the ship was designed for riveting.

Little knowledge has been gained regarding the extent to which welding has been applied to the construction of submarines, but it is known that a few years ago, Messrs. Vickers Armstrongs Ltd., completed the building of three submarines for the Portuguese Government, at their Naval Construction Works at Barrow-in-Furness. These submarines, which were built simultaneously side-by-side, had all their internal structures and the non-pressure external shell welded. The pressure hull was riveted, with the exception of diving tanks in externals which were welded and tested to a pressure of 142 lbs. per sq. in.

The hull of these vessels was constructed of both high tensile and mild steel. As weight was the main consideration in the design of these submarines, it can be gathered, that the advantages gained by utilizing welding were extensive. Also, by using this method of construction, the use of numerous sections usually associated with submarine building could be eliminated.

These submarines when completed were submerged to a depth of 328 ft. on trial, and the results of the welding were considered by responsible authorities to have been remarkable.

Application of electric arc welding in the construction of U. S. warships dates back to the days immediately following the last war.

Since electric arc welding has been applied to ship construction in the United States, a number of all welded auxiliary craft have been completed. Vessels of this type have their hulls entirely welded, and on nearly all of them the fittings were entirely built up of welding. The vessels included mostly self-propelled ships, such as seaplane derrick barges, lighters, tugs, etc. They ranged from 65 ft. to 120 ft. in length.

At present, two all welded cutters are under construction for the United States Coastguard. The welding is being done in accordance with the United States Navy specification. All the electrodes used are on the Navy approved list, and all operators have to pass the latest qualification test. In these vessels the entire hull forward and the waterline belt is plated ⅞ in. thickness on the lap, top and bottom, is filled with a full welded fillet, full length to eliminate any sharp edge to cut on the ice. A great deal of the interior structure is also welded.

It has been announced that the 35,000 ton battleship "Washington" under construction at the New York Naval Yard, Brooklyn, contains a large amount of welding, and that about 35 per cent of the structural steel of the ship has been welded. In a ship of this displacement welding would show a great saving in weight, which can, of course, be used either for protection or offence.

Spot Welding of Structural Steel Sections

"Forge-Welding" is a new process of heavy duty electric resistance welding for spot welding heavy steel and iron sections heretofore considered impossible to weld with conventional equipment. With it, such work can be handled almost as easily and rapidly as spot welding sheet metal.

The process as announced by Progressive Welder Company, 3033 East Outer Drive, Detroit, Michigan, has the promise of opening up new fields for resistance welding in the fabrication of structural steel assembly. Even the fabrication of heavy sections for defense equipment which are expected to come within its capacities may prove to be of tremendous importance in the defense program.

In principle the process harks back to — and derives its name from — one of the earliest forms of welding: heating, forging, reheating, re-forging, etc. In comparison, however, the new process is extremely rapid. Although developed over a year ago, announcement had been with-held pending completion of field tests on various types and thickness of metals under actual service conditions.

Typical Work

Typical of work now being handled is: welding of two pieces of ⅜ in. stock to a 1 in. section; welding together two 1 in. sections, etc. Suprisingly, resistance "Forge-Welding" requires no highly specialized or expensive equipment. In effect the welding is done on a variation of standard spot welding equipment.

Resistance "Forge-Welding" consists of first applying pressure to the work, then interrupted current, and finally super-imposing a hammering action on the electrode. Under high pressure and with sufficient heat, the surfaces of work are brought into such intimate contact that when additional "impact-pressure" and intermittent heat are applied a forged weld of superior quality is obtained.

Forging Effect

To secure the forging effect while yet holding the work under pressure, a compound action "Hydro-Booster" is used. With it, a rapid succession of blows can be superimposed upon the initial constant pressure under which the work is being held.

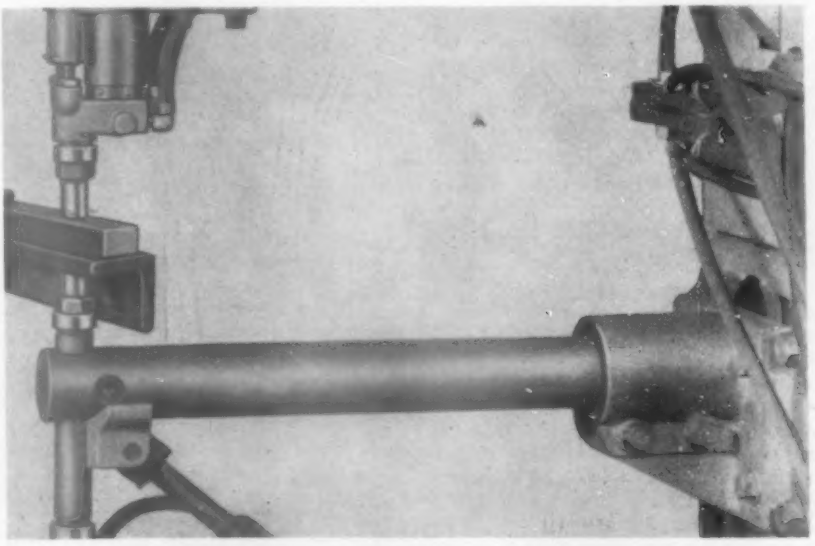
The equipment recommended consists of a standard pedestal-type welder having the compound "Hydro-Booster" mounted on the upper arm immediately above the welding electrodes. The booster consists essentially of two chambers, one above the other, each capable of receiving air under the usual 90 lb., factory line pressure individually or separately. The piston of the upper chamber can act on the top of the lower piston to increase the resultant welding pressure. In this manner, the lower piston supplies the necessary initial pressure, while the upper piston, acting independently, can super-impose the hammer-blows required for the operation. Thus, the initial pressure of 2,000 lbs., together with sufficient heat, brings the surfaces of the work into intimate contact, and the combination of interrupted heat and intermittent hammering (approximately 1,000 lbs. per blow) combine to complete the weld.

Special equipment required is of the "accessory" type. A special timer which can control the sequences of operation for any condition yet encountered, is used. A special alloy type of electrode has been developed to withstand the high pressure and heat.

Size of spots vary according to metal, etc., but generally on work totaling 1½ in. thickness the spot will be approximately 1 in. in diameter near the surfaces with the diameter about 50% larger as it approaches the mid-section — typical of forging action.

To suit varying metal thicknesses, types of alloys, etc., the number of heat interruptions and "forging" blows can be varied. On certain types of work, interruptions of heat and application of "forging" pressure will be synchronous, while on other types of work heat and pressure is applied alternately.

Portable spot welding guns can be used for Resistance "Forge-Welding"—primarily on work up to about ½ in. by ½ in. With such equipment the process differs in that pressure is supplied in two stages: first, a welding or contact pressure, then a heavy "squeeze" or forging pressure. Otherwise the operation is essentially the same. The reason is, of course, that with the portable gun, "Forge-Welding" head would be too cumbersome. On large guns for special work when the gun suspension is properly engineered, "Forge-Welding" has proved satisfactory.



Spot welding a 1" thick bar to a ⅜" thick angle.

New Product Developments

New Acme Type 3 "Hot Spot" Welder.

Acme Foot Operated Spot Welders

★ As companion lines to the recently announced Types O and 1 foot operated **"Hot Spot"** welders, manufactured in 10, 15 and 20 KVA capacities, the **Acme Electric Welder Co.**, Huntington Park, Cal., announces foot operated rocker arm Type 2 in 20 and 30 KVA transformer capacities, and Type 3 in 40 and 50 KVA transformer capacities.

The streamlined housings of these spot welders are all-welded fabricated steel. Horns are double and reversible, one end machined to hold electrodes at 90 degree angle and opposite end 22½ degree angle. The arrangement of the swivel lower horn holder on a long column allows for horizontal and vertical movement of the lower horn to facilitate welding in hard-to-get-at places and deep pans or boxes.

Special features include clamping block devices which retain the horns in the horn holders with perfect electrical contact, yet can be instantly released for change of set-up. Extra heavy rocker arm is of malleable iron as are all major cast working parts. Steel rocker arm brackets are bronze bushed. These welders are built for 24 hour continuous service and carry a lifetime guarantee.

Complete details are outlined in new Bulletin No. 51 which will be mailed to those interested on request.

» «

New Manganese Molybdenum Welding Rod

★ The **American Manganese Steel Division** of **The American Brake Shoe & Foundry Company**, 389 E. 14th St., Chicago Heights, Ill., has introduced Amsco Mo-Mang welding rod, described as a low cost manganese-molybdenum steel welding rod for building up worn high manganese, carbon steel and gray iron castings. It is available in 18-in. lengths in the bare form for straight D.C. welding and in the combination coated form for both D.C. and A.C. application.

Amsco Nickel Manganese is intended for applications that demand high tensile strength and/or extreme shock resistance. Amsco Mo-Mang does not replace Amsco Nickel Manganese Rod but is recommended for straight build-up welding to compensate for wear as encountered by bucket lips, crusher hammers, jaws, etc. In these applications, Amsco Mo-Mang is a satisfactory and economical welding rod.

A new Bulletin W-30 and samples for test are available upon request.

» «

New G.E. D-C. Arc Welder

★ The **General Electric Co.** has announced a new **200-ampere, d-c arc welder** which will provide any welding current from 25 to 250 amperes. This wide range allows all-day manual welding to be done with currents up to 200 amperes, using electrodes from 1/16 to 3/16 inch in diameter. Capacity is also provided for the use of electrodes as large as ¼ inch on occasional short jobs.

The new arc welder has two outstanding features. First, it provides for instant recovery of the voltage to an extent greater than the arc voltage after each

General Electric's new 200 ampere D-C Welder.

short circuit, thus preventing time-wasting arc pop-outs. Second, it never allows current peaks to exceed three times the steady short-circuit current on any adjustment, thus preventing excessive heat and spatter and resulting in a saving of electrodes. Both of these features are made possible by a split-pole cross-field design with which the equipment is provided.

Other advantages of the new arc welder include excellent commutation, isothermic overload protection for the motor, self-excitation, which does away with the necessity for an extra generating unit; quick adjustment of welding current, and horizontal mounting.

Self-sealed ball bearings are used. An improved, highly efficient ventilating system is said to prevent overheating even when the welder is operated within the proper range hour after hour. A full range of current adjustment is obtained without the use of a current resistor. It is claimed this results in a saving of 10 to 15 per cent of power costs.

A-C Power Unit Has Integral Exciter, Regulator and Control

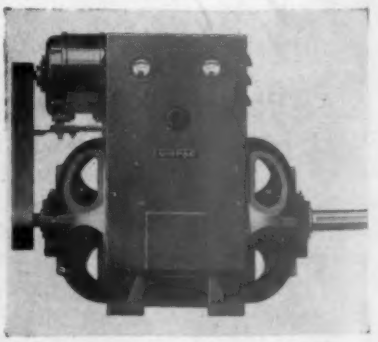
★ A new and completely self-contained a-c generating unit which regulates, controls, and meters its output has just been announced by the **Westinghouse Electric & Manufacturing Co.** Called the **"Simpac"** power unit, it combines a standard open-type a-c generator, a direct current exciter, exciter field rheostat, voltmeter, ammeter, and optional voltage regulator in one integral unit. The **"Simpac"** was designed especially to fill the need for a completely self-contained generating unit for use in out of the way localities, or for special requirements in industrial plants. It may be either engine or electric motor driven, direct or belt connected.

Construction is simple, yet rigid and strong. The d-c exciter is mounted on a fabricated steel shelf above the generator and is driven off the generator shaft extension by a V-belt. The control, regulator, and meters are enclosed in a sheet steel cabinet fastened to one side of the generator frame. Thus the entire unit requires very little more space than the actual generator frame, and is mounted or supported by generator frame feet.

Voltage is adjusted manually by the exciter field rheostat, the voltmeter being in plain sight of the operator. Generators employed have an inherent voltage regulation of 10% at 80% power factor. Should this not be sufficient, it is stated that the voltage variation may be improved to as low as 1½% by use of a "Silverstat" automatic resistance type regulator. Space for the "Silverstat" is provided for in the control cabinet.

Ratings from 3.75 kva to 187 kva are available voltages of 120/208, 240 or 480, with operating speeds from 600 to 1800 rpm. Units above 187 and up to 312 kva may be obtained with separately mounted controls. All come wired and assembled.

For additional information write Dept. 7-N-20, **Westinghouse Elec. & Mfg. Co.**, East Pittsburgh, Pa.



The new Westinghouse "Simpac" power unit consisting of a-c generator. belted exciter, regulator. and control.

Two New Welders by Lincoln

★A new 200-ampere engine-driven arc welder, which is said to be exceptional in light weight, small size, and low cost for an engine-driven unit of its capacity was recently announced by **The Lincoln Electric Co.**, Cleveland, Ohio.

The new welder, designated the **"SA-200 Junior"**, (see Fig. 1), affords a new experience in moving and handling engine-driven welding equipment. It is light enough to be wheeled readily by one man, or lifted easily on its single

New 200-ampere engine-driven welder is a light weight.

balancing hook by average moderate-capacity chain or crane falls. The weight is under 900 pounds with running gear.

The "SA-200 Junior" meets requirements for a wide range of applications for direct current arc welding. It is claimed to produce a uniform current for speedy welding of practically all metals and alloys with either bare or shielded arc type electrodes.

The "Lincoln Junior" is available as a portable unit with steel-wheeled running gear and as a stationary unit, either for fixed mounting in the shop or for installation on a truck or trailer.

A new small motor-generator type arc welder as shown in Fig. 2 is said to provide greater convenience and accuracy in welding.

The new welder, known as the **"SA-200"**, has both job selector and current control calibrated and equipped with dials which indicate the type of work and number of amperes for each and every setting.

The "SA-200", despite its moderate size, has a large number of welding applications within its scope. Its utility is broadened by the use of class B insulation. Complete absence at proper points of inflammable materials, such as cotton, linen, fiber, wood, bakelite, etc., enables the machine to withstand sustained operation under overload conditions. It can be used with electrodes as heavy as ¼-inch.

Lincoln's new SA-200 motor generator type welder.

» «

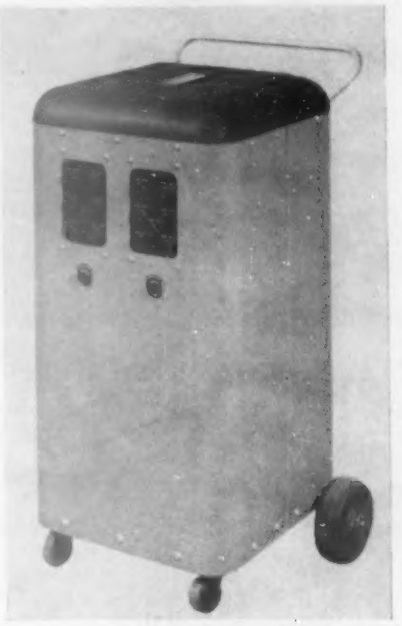
Bakelite Goggle for Welding and Chipping

★ **Acetylene & Oxygen Supply Co., Inc.**, 30-30 Northern Blvd., Long Island City, N. Y., following a lengthy investigation and study of operators' requirements in welding and chipping goggles, have introduced a new **Metro Bakelite 50 mm Goggle** with metal ventilators. No light is permitted to come in contact with operator's vision; no back flashes can interfere with welding operations.

Metro goggles are of bakelite construction with metal ventilators.

The ventilating arrangement consists of two pressed-steel pieces; one with two louvres facing the front, with the second piece covering the louvres, keeping out the light; the opening facing the back. The bakelite used is an impact-resistant type, sufficiently strong to resist breakage if dropped.

Acetylene & Oxygen Supply Co., Inc., has also introduced four new model Metro welding helmets, and three new type hand-shields. Descriptive material covering these new items will be forwarded upon request.



Greyhound welders are guaranteed for five years.

Advanced A. C. Welders

★ The **Greyhound Electric Mfg. Co., Inc.**, 31 Grand St., Brooklyn, N. Y., announces the new **Greyhound Industrial 300 Ampere Continuous Duty A. C. Arc Welder** with 28 heat stages.

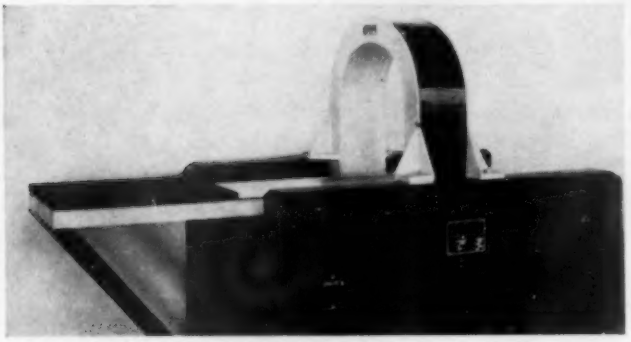
This model has been specifically designed to weld No. 20 Gauge metal with ease, as well as the heaviest of metals. Because of Greyhound's stability of arc, welding can be done in the vertical and overhead positions as well as in the flat and horizontal positions. Greyhound welders, it is claimed, give a non-blowing arc in all welding positions either on light or heavy metal.

This new industrial model, it is claimed by the manufacturer, is capable of giving twenty-four hours of continuous welding service. All Greyhound models are manufactured with double windings in the transformers, and a separate reactance. The transformers are wound with asbestos and woven spun glass insulation. The high grade silicon steel core is oversize, which is claimed to insure against over-heating.

Greyhound welders are designed so as to weld successfully with any type and grade of A. C. coated electrodes. The open voltage is 60-90 volts, which automatically changes on the various amperage taps. The manufacturer also claims that this variation of voltages on the different amperage taps not only gives ideal welding flexibility of arc, but is most economical, time-saving and efficient. The key-word of Greyhound is the easy striking and maintaining of the arc at all heats.

Greyhound welders are available in five models:

15 to 100 amps	12 heat stages
15 to 125 amps	16 heat stages
15 to 175 amps	20 heat stages
15 to 250 amps	24 heat stages
15 to 300 amps	28 heat stages



Magnaflux Demagnetizer may be obtained for either manual or automatic operation.

Magnaflux Demagnetizer Units

★ The new **Type SB Demagnetizers,** used with DC Magnaflux inspection units, are made in openings of 5 x 7 in., 9 x 11 in., 14 x 16 in., and 28 x 14 in. The 5 x 7-in. size is made for bench mounting. The 9 x 11-in. size is mounted on its own stand, and the two larger sizes are mounted on their own stands and equipped with conveyor track and roller carriage for the easy handling of heavy parts.

Outstanding improvements include the approximate doubling of demagnetizing efficiency, and a great reduction in the length of the coil which reduces space, and makes for much easier operation.

Information on these units which are furnished for either manual or automatic operation may be obtained from the **Magnaflux Corp.,** Chicago, Ill.

» «

Tungsten Electrical Contacts

★ The **Metroloy Company, Inc.,** 57 E. Alpine St., Newark, N. J., announce they are now manufacturing **electrical contact points,** made from highly fused pure tungsten metal. It is stated that by their method of manufacture uniformity in grain structure is assured, eliminating any excessive oxidization or pitting during operation periods.

The purity of this metal is claimed to avoid film coatings from adhering to contact surfaces during the time when apparatus is not operating or at shutdown intervals.

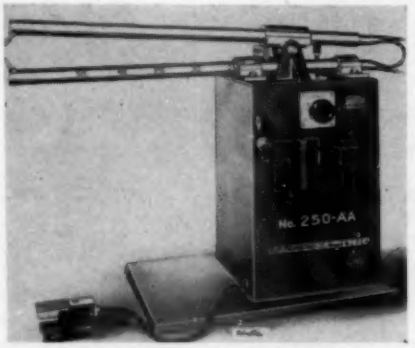
It is further claimed that due to elimination of these difficulties that the electrical contact surface resistance is maintained at a minimum and that long service operation is assured.

» «

50 KVA Long-Horn Spot Welder

★ The **Eisler Engineering Co.** of 740-770 So. 13th St., Newark, N. J. has placed on the market a **long-horn spot welder No. 250-AA** for deep sheet metal work. The new feature on this machine is that both upper and lower horns can be lengthened or shortened to meet the requirements of the size and type of work. The new horn adjustment makes it possible to weld light and heavy work and deep metal parts. The markings on the horn represents the KVA ratings—when the horn is placed on the 25 KVA mark it represents 25 KVA, etc.

The spot welders are made with many different styles of electrodes, and in this case, the cooling water goes through the entire horn. Eisler spot welders are made foot, air, or motor operated and will weld from 30 to 150 spots per minute, depending on the nature of the work. Available in three sizes: 5 to 25 KVA, 25 to 50 KVA, and 40 to 75 KVA with horn lengths of 30, 36, or 40 inches. Various types of fixtures and attachments are supplied when required for a particular problem.



This Eisler longhorn Spot Welder No. 250AA is air operated.

» «

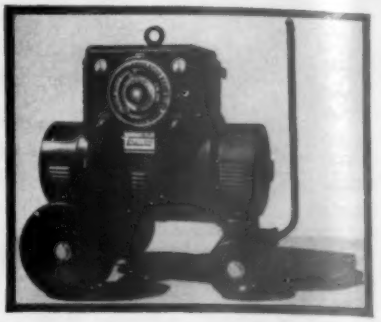
Photoswitch Short Interval Timer

★ **Photoswitch, Inc.,** Cambridge, Mass. announce a new **Electronic Timer Type T15** is a universal interval timer, extremely accurate over ranges from 1/20th of a second to two minutes. Control is accomplished through a specially designed snap-action relay of 1,000 watts capacity, which results in an accuracy that is claimed to be hitherto unapproached in simple and rugged timers.

The equipment is flexible with reference to actuating control, permitting both momentary push button and sustaining contacts control. It is universal for six timing ranges represented by timing valves snapped into a readily accessible clip.

Timer Type T15 has been designed with an accuracy permitting complete interchangeability of equipment. Thus, machine process calibrations for one timer apply to all timers.

The unit has been designed throughout for an unlimited life which is guaranteed to match that of any machine to which it is applied.



New "Hobart Aircraft" is designed to meet arc welding requirements of aircraft industry.

New Welder for Aircraft Industry

★ The **Hobart Brothers Co.,** Troy, Ohio, announces the development of a new motor-generator type of DC arc welder, the **"Aircraft Special,"** designed specially to meet modern requirements of production welding in Aircraft Factories. This new welder is said to provide high striking voltage that makes possible the exceptionally "hot start" required in welding light gauge alloys of the type generally used for aircraft construction. The welding range is from 15 to 125 amperes, or 100 amperes continuous service.

The machine embodies all the standard Hobart features of Multi-Range Dual Control, Remote Control, all-welded steel-construction, end mounted ball bearings, two-way ventilation, convenient link changeover for 220/440 vlots power, 4-Pole, Inbuilt Exciter, etc. Although known as the "Aircraft Special," this new Hobart Arc Welder is also available for other applications of light gauge welding and has already received favorable comment in connection with certain operations involved in welding galvanized steel in shipyard production work.

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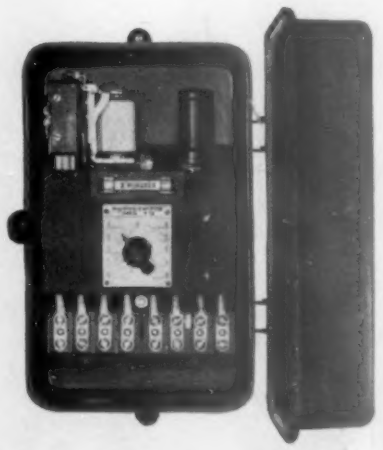

Electronic timer type 115 has range from 1/20 second to 2 minutes.

See
Welding Demonstrations
at our Exhibit
Space E-22
National Metal Exposition
Cleveland, Oct. 21-25

All failed in the parent metal

NOT ONE FAILED IN THE WELD

Laboratory inspected cast-iron bars were cut in two, the edges beveled, then welded together with Tobin Bronze... and subjected to straight pull strength tests. All failed in the cast iron...there were no failures in the Bronze! Tobin Bronze* is uniformly dependable—welders like the way it flows, and the tough, strong, durable bonds it produces.

The uniformity of Tobin Bronze is the result of expert metallurgy, close inspection and accurate laboratory control. That's why you can always count on Tobin Bronze.

There are 18 Anaconda Welding Rods ...each suitable for a special purpose. Their characteristics as well as welding procedures are outlined in detail in Anaconda Publication B-13. A copy will be mailed to you — without cost — for the asking. 40122

* * *

Visit the Copper & Brass Industry Exhibit in the Hall of Industry, New York World's Fair, 1940

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*Reg. U.S. Pat. Off.

ANACONDA
from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut
In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Company

Improved Erection Method for Welded Steel Construction

★ **J. H. Williams & Co.**, Buffalo, N. Y. are now manufacturing the patented **Saxe Welded Connection** used in the erection of welded steel structures. These connections, consisting of an erection seat and an erection clip, have a wide application and are adaptable to any assembly where structural steel parts must be located and held for welding. The manufacturer states that savings ranging from $3.00 to $5.00 per ton have been effected.

Two steel members securely held in exact position by Saxe Connectors. Inset: The Saxe Clips and Saxe Seat.

The simple hook and eye principle of the Saxe System not only securely locks the steel members in position but its self-aligning action eliminates many hours of costly plumbing up necessary when the usual riveting method is employed. Economy, simplicity and speed are among the advantages claimed for the Saxe method. The manufacturer points out that the Saxe System has proven safe and dependable thru wide use in scores of buildings of various types over a 10-year period. No specially trained labor nor special equipment is needed for the use of these connections and their use does not in any way impede or delay other structural operations.

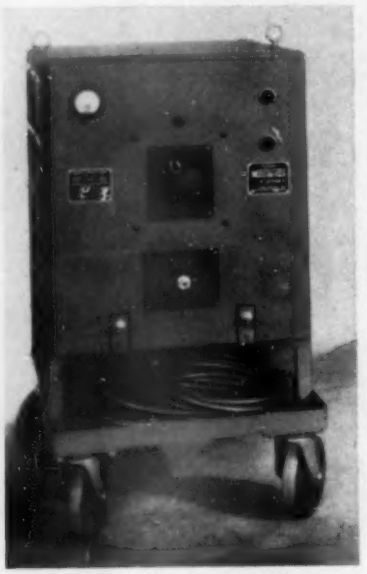
Full particulars can be obtained by addressing J. H. Williams & Co., 400 Vulcan St., Buffalo, N. Y.

» «

Pipe Template Patterns

★ **F. W. Bollman**, 419 Vine St., West Lafayette, Ind., announces a new and enlarged set of **Welder's Pipe Template Patterns.** The set consisting of 20 blueprints measuring 30 x 40 in. which contain nearly 300 template drawings. There are included layouts for tees, ells, laterals, reducers, bull plugs and other pipe fittings.

These template patterns are claimed to be quite complete. It is stated that a layout for any type of pipe fitting may be obtained by merely transferring the proper outlines from the template pattern sheet to the pipe.



New Portable Inspection Unit.

Magnaflux Inspection Unit

★ The **Magnaflux Corp.**, 5908 Northwest Highway, Chicago, announces a new **Portable Inspection Unit,** Type KQ-1, particularly adapted to the inspection of welds. The KQ-1 operates on 220 or 440 volts, three phase, 60 cycle AC, and delivers full-wave rectified current. The output current is up to 600 amperes DC for continuous service, and up to 1200 amperes DC may be drawn intermittently. Remote control is provided so that one-man operation is possible.

This type of unit is also made in type KQ-04 which delivers up to a maximum of 400 amperes DC.

Both units are very sturdily constructed, with heavy 8-in. composition swivel casters for easy handling around the shop. This type of current has been found to give most sensitive results in the location of both surface and subsurface defects in welds, castings, etc.

» «

New Federal Flash Welder

★ The **Federal Machine and Welder Co.**, Warren, Ohio, has introduced a new design flash welder. Known as the **Federal type F-4**, the welder embodies features which have been satisfactorily used by Federal for many years in their regular line of flash welders. The machine, itself, is built with flat top platens on which may be mounted various types of clamping fixtures to accommodate the varieties of welding jobs which may be accomplished on this type of equipment. Parallel keyways being provided on these platens assures accurate alignment of the clamping fixture which is bolted on the platen surfaces.

The drive mechanism is motor driven through a variable speed drive and a substantial gear reducer unti to the cam which controls the flash and upset period of the weld. This cam, which is carried on a vertical shaft, is also covered over to protect the flash and dirt from building up on the face.

It is claimed that these improved features not only lend a neat appearance but also provide very little maintenance cost which is a very desirable feature in flash welding equipment.

This machine is made in transformer capacities up to 150 KVA, suitable for welding stock up to one square inch welding area and may be used for rounds, flats or formed sections, according to the customer's requirements.

» «

New Two-Stage Sight Feed Regulator will fit all Sight Feed generators.

Sight Feed Two-Stage Regulator

★ **The Sight Feed Generator Co.**, Richmond, Ind., announce a new **Two-Stage Regulator** for the Sight Feed acetylene generators. It is claimed that the use of this regulator assures an absolutely even back pressure at all times. In this manner all fluctuations in pressure in the generator are prevented from reaching the torch.

This new regulator will fit any model Sight Feed generator. It is installed in the outlet valve opening and while it is regularly furnished with one service outlet valve models with two valve openings are available.

Federal type F-4 welder embodying many new features.

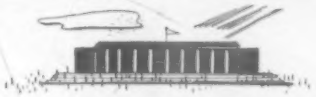
SELLING IS *Easier*

THE METAL EXPOSITION WAY!

Why? . . . because the best prospects in the metal industry *come to you* at the National Metal Exposition. Come, eager to see what's new in their field . . . to inspect materials and equipment in actual operation . . . to compare . . . to analyze . . . and to *buy!*

These men are the cream of purchasing power in your field. Last year's 33,000 registration included a high percentage of Presidents . . . Vice-Presidents . . . Treasurers . . . Managers . . . Metallurgists . . . Engineers . . . Superintendents . . . Chemists . . . Purchasing Agents—men who specify and buy every type of metal product.

More manufacturers than ever before will exhibit in this year's National Metal Exposition at Cleveland. There are still plenty of choice spaces left at the regular $1.00 per sq. ft. rate. Write or wire collect today for floor plan and full information. Address: W. H. Eisenman, Managing Director, National Metal Exposition, 7301 Euclid Avenue, Cleveland, Ohio.



BIGGEST IN HISTORY!

Over 275 leading manufacturers have already reserved 90,000 square feet of exhibit space . . . making the 1940 National Metal Exposition the largest in the 22 years it has been managed by the American Society for Metals . . . proof that more and more companies find selling easier the Metal Exposition Way.

STRATEGIC LOCATION!

Cleveland is the hub of the most diversified manufacturing district in the country . . . home of many famous industrial organizations . . . easily accessible from all parts of the country . . . ample convention facilities . . . a city in which many successful Metal Expositions have been held.

GUARANTEED ATTENDANCE!

Four national engineering societies: American Society for Metals; American Welding Society; The Wire Association; and Iron & Steel Division and Institute of Metals Division, American Institute of Mining & Metallurgical Engineers . . . hold their annual Metal Congress in conjunction with the Metal Exposition . . . assuring the highest type attendance.

NEW AIDS TO PRODUCTION!

If you have a new aid to production . . . a better metal . . . a faster machine—your business demands representation with other leading companies at the Metal Exposition because buyers for every big industry will be shopping there. Get your share of the rush business ahead . . . exhibit at the Metal Exposition!

The WORLD'S GREATEST EVENT IN THE METAL INDUSTRY 70% NEW ATTENDANCE EACH YEAR

NATIONAL METAL EXPOSITION

AND METAL CONGRESS

OCTOBER 21-25, 1940 *Cleveland, Ohio*

MANAGED BY AMERICAN SOCIETY FOR METALS

FLAME CUTTING

(*Continued from page 32*)

ever, when flame-cutting is used. Not only are they obtained quicker and cheaper but without causing production delays that would be incurred were it necessary to produce them by stamping, shearing or casting.

When welded fabrication is undertaken, flame-cutting becomes an indispensable tool. In Figure 8 there is shown an inner member for a 2225 HP electric coupling. On this arc welded fabrication the structural plates were pre-formed and then torch shaped. As in the previously described applications, a worthwhile saving was effected by flame-cutting.

Not only will flame-cutting and shaping speed up production as far as National Defense is concerned but it will free some of the so-called "bottlenecks in industry." By eliminating in some industries the need for dies and heavy presses, the manufacturers of these tools will be free to direct their efforts towards the production of other needed tools. In a similar manner the cutting torch will free the pattern shop and foundry to a certain extent so that these industries may have increased capacities for the serving of more urgent needs.

Fig. 6—This transmission cover is being cut from the layout on the plate. (Photo Linde Air Products Co.)

Fig. 7—The plates for this electric coupling were pre-formed and flame cut. (Photo Westinghouse Electric & Mfg. Co.)

» «

HIGH NICKEL ALLOYS

(*Continued from page 54*)

or less in thickness, but for .156 in. ($\frac{5}{32}$ in.) and thicker material, edges should be beveled to 37½° (75° total included angle) for vee joints, and beveled 15° for "U" and "J" grooves. In all cases, it is desirable to retain a lip of $\frac{1}{16}$ in., or slightly more, at the base of the bevel.

To obtain uniform, accurate fits, beveling is done best by machine, usually on a plate planer or other machine tool. Neither oxy-acetylene nor carbon arc cutting are recommended, as the cuts made are very poor and the area adjacent to the cut is oxidized badly.

Electrode requirements for various types of manually welded joints in Monel, nickel and Inconel are given in Table 16.

(*Continued on page 68*)

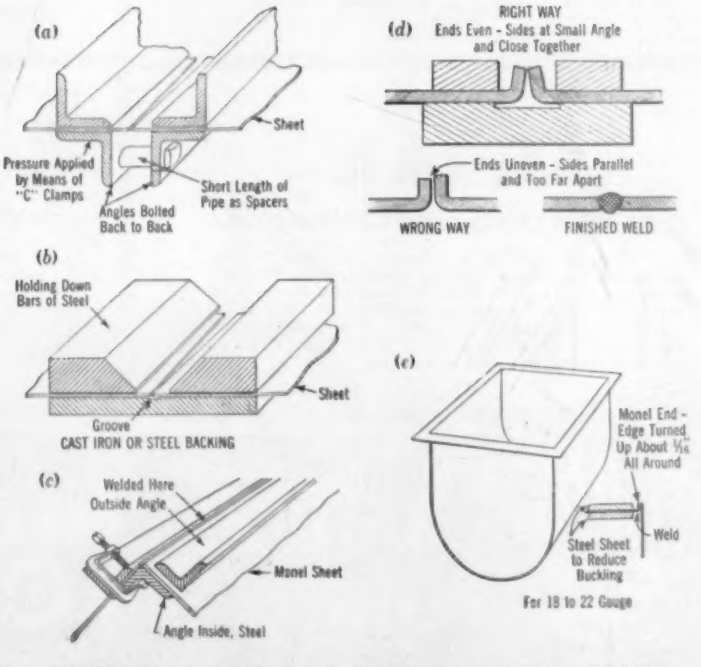


Fig. 16—Simple commonly used jigs for oxy-acetylene Welding.

You are invited to attend this Outstanding Welding Event!

21st Annual Meeting

AMERICAN WELDING SOCIETY

Cleveland Hotel · Cleveland, Ohio

October 20-25, 1940

LEADING scientists, engineers, and executives will gather from all parts of the country to participate in this meeting of the American Welding Society. In the technical sessions, and the welding exhibits which will be presented in conjunction with the National Metal Exposition, they will bring you up-to-date on the welding progress which has been made during the past year. They will give you hundreds of ideas to take home and use.

Your Opportunity

You and your associates are cordially invited to attend all the sessions, meetings, and events which are part of this Annual Meeting. Here you will have a chance to discuss your problems with men who are authorities on welding. One idea obtained at this meeting may be worth the cost of attendance many times over.

Important Sessions

Technical papers covering practically every phase of welding will be presented. There will be sessions on Structural Welding, Machinery Welding, Procedure Control and Special Applications, Resistance Welding, and Pipe Welding. There will also be two sessions on Fundamental Research, another on Industrial Research, and a session on Combined Fundamental and Industrial Research. In addition, there will be meetings devoted specifically to the Steel, Shipbuilding, and Railroad Industries.

Special Features

The special features will include the President's Reception on Sunday afternoon, the Presentation of Medals and Awards on Monday morning, the opening of the National Metal Exposition at noon on Monday, the Annual Banquet on Thursday evening, and an Inspection Trip on Friday afternoon. There will also be an interesting program of entertainment and social events provided for the ladies.

A record attendance is expected—so you are urged to make your reservations early. A copy of the program can be obtained by writing to the American Welding Society.

No one interested in welding can afford to miss this year's Convention. Plan to attend now.

American Welding Society · 33 West 39th Street, New York, N. Y.

High Nickel Alloys

(*Continued from page 66*)

Proper jigging to hold the metal firmly in place facilitates the welding operations greatly, particularly by minimizing buckling. This is true, not only for non-ferrous alloys of high melting point, but for steels as well. By jigging is meant the holding in position and alignment of the edges to be welded.

Jigs and Clamps

In designing jigs for gas welding, it is necessary to provide either a groove underneath the joint, as in Fig. 16b, c or d, or to have an open jig as in Fig. 16a. The groove serves as a mold for weld metal and thus provides for uniform penetration. The absence of a groove or space would make welding very difficult. Steel or cast iron are most widely used for gas welding jigs.

Jigs for electric arc welding are designed similarly, with a groove provided to permit penetration of weld metal. Grooves should be extremely shallow, usually 1/64 in. to $\frac{1}{32}$ in. maximum depth, and $\frac{3}{16}$ in. to ¼ in. wide. Square cornered grooves should be avoided. Flat surfaced steel or copper backing bars are not recommended for butt joints in .050 in. and thicker material, because of the possibility of trapping flux at the bottom of the weld. Backing bars for arc welding should be made of copper; hold down bars may be either copper or steel.

New Products

New Austenetic, Tough, Non-Magnetic Steel Available

★ **Manganal**—an austenetic, tough, non-magnetic steel containing 11 to 13½% manganese and 3½% nickel is now carried in stock for immediate shipment by **Joseph T. Ryerson & Son, Inc.**

In making available a non-magnetic, abrasion resisting steel which can be welded, a real industrial need has been filled. For example, considerable weight can be saved in building composite structures by welding castings and Manganal plates, using manganal only where necessary for wear resistance. The 3½% nickel content permits Manganal plates to be welded without a subsequent quenching treatment as there is no loss in toughness when Manganal is cooled from the welding temperature. This makes a reasonable structural material of a composition that otherwise is difficult to handle. Welding rod of 18-8 stainless composition has been found to give very satisfactory results when used with Manganal.

Manganal has all the advantages of 11-14% manganese steel in resistance to wear and surface work hardening. Thicknesses up to ½ in. can be sheared. Manganal can be flame cut, and requires no subsequent heat treatment when formed or punched hot. This characteristic, it is claimed, gives Manganal a distinct advantage over 11-14% manganese steel which must be given a full heating and quenching treatment after forming if the original toughness and ductility is desired—a treatment which often distorts the formed shapes.

Chemical composition and physical properties of Manganal are:

Carbon .60 to .90
Manganese 11 to 13½%
Silicon .60 to .95
Nickel 2.50 to 3.50
Tensile Strength 140,000 to 150,000 lbs. per sq. in.
Elastic Limit 55,000 to 60,000 lbs. per sq. in.
Elongation in 2 in 72½%
Reduction of Area 54%

Hot Rolled Manganal Plates are currently being used for electrical applications where non-magnetic characteristics rather than abrasion resistance, are required. Welders are successfully using Manganal for patching broken and worn-down parts made from 11-14% manganese steel. It is also being used as a substitute for heavy castings where weight reduction is important. Manganal is strong and durable, and under proper application, will resist impact and abrasion many times longer than ordinary carbon steel. Typical applications include journal boxes, pedestal liners, wear plates, mill liners, shovel buckets, conveyors, crusher hammers, etc.

Hot Rolled Manganal steel is carried in stock by Ryerson in 48 in. x 120 in. plates in the following thicknesses: ⅞ in., ¼ in., ⅜ in., ½ in., ⅝ in., ¾ in., 1 in.

» «

Spot Welding Electrode for Stainless Steel

★ **Mallory 22 Metal**—a cold-worked copper alloy used mainly as a resistance welding material, especially on stainless steel, terneplate and other coated metals has been announced by **P. R. Mallory & Co., Inc.,** Indianapolis, Ind. Particularly recommended for hydromatic welding machines or other applications where water cooling is poor or impractical. High annealing point—(450°C or 840°F) is a decided advantage where tips are not drilled for water-cooling. Supplied in wrought form only—rods, extruded and drawn bars, forgings, finished machines tips and parts.

Uniform Rods MADE WITH UNIFORM QUALITY PQ SILICATES OF SODA

WHETHER you make rods or use them, you appreciate the dependable binding action of PQ Silicates of Soda. The uniformity of every delivery of PQ Silicate enables the manufacturer of rods to maintain his quality consistently, and insures efficient performance to the user.

Our Bul. 241 contains useful information. Send for it.

Philadelphia Quartz Co.

General Offices and Laboratory: 125 South 3rd Street, Philadelphia.
Chicago Sales Office: 205 West Wacker Drive. Stocks in 60 cities.

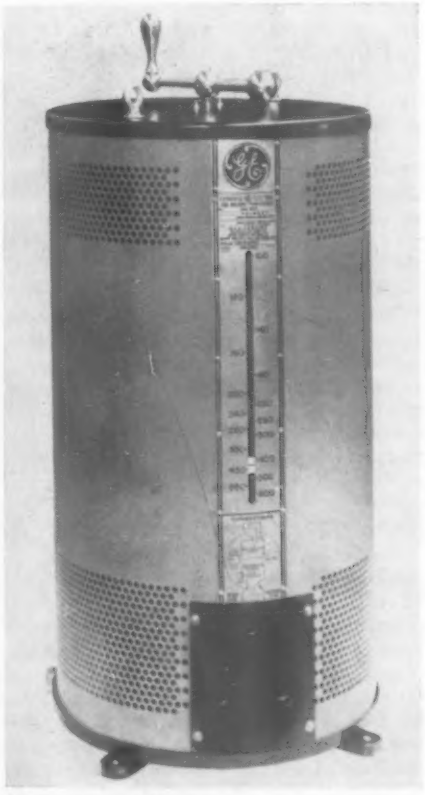
SILICATE OF SODA *SPECIALISTS*

Now Is the Time to Join the
AMERICAN WELDING SOCIETY
•
33 West 39th St. New York City

New 500-Ampere A-C Arc Welder

★ The **General Electric Co.**, Schenectady, N. Y., has announced a new line of **500-ampere A-C Arc Welders** offering advantages in performance and economy resulting from mechanical improvements and a new electrical design which incorporates power-factor correction.

This built-in feature is claimed to make possible a greatly increased power-factor, which practically eliminates the useless lagging current drawn by conventional designs. Consequently, smaller primary cable, line switches and fuses can be used. This often results in a saving on installation costs and makes possible the addition of more welders to existing feeders without causing overload. Any tendency toward an unbalanced load is reduced by one-third.



Low power factor featured in new 500-ampere AC Welder.

When operated below half load, this welder provides leading reactive kva for improvement of the shop power-factor; and when operated at no load, there is 19.5 kva available for this purpose.

Other advantages offered by this new G-E arc welder include finger-tip adjustment by means of an easily turned current changing crank; a large, easily read current indicator extending up the side of the transformer case; protected output terminals accessible through holes in the insulating panel; and fan-forced ventilation, providing cool, dependable operation even at high currents or high-duty cycles.

The only maintenance said to be required is the lubrication of the fan and current-adjuster every 12 to 18 months. The case, however, is easily removable so that inspection can be made, if desired.

» «

Three New Electrode Holders

★ The **Churchward Engineering Co.**, 43 Sperry St., New Haven, Conn., announces three new models **Duro Electrode Holders.** One, the **Duro Holder No. 500,** has been designed to fill the need for a real heavy duty holder which will be comparatively light and easy to handle. It is claimed that this holder will remain cool at 500 amperes and is perfectly balanced. The aws are sturdy and will give exceptionally long life. The holder has been tested by one of the largest users of welding in the world and they reported that it gave exceptionally fine service when used at 500 amperes.

As a companion holder for 400 ampere service, there have been designed the **Duro Holders No. 400** (plain) and **No. 400-I** (fully insulated). The type 400 holders are said to be sturdy enough to stand up well at 400 amperes, yet sufficiently light and so balanced as to be used efficiently for lighter service.

Showing metallographic microscope in Bridgeport's new laboratory

BRIDGEPORT'S "1232" SILICON BRONZE WELDING RODS

FOR TANK WELDING

For your next job of welding range boilers, storage tanks, automatic heaters and similar articles—made of silicon bronze sheets—use Bridgeport's "1232" Silicon Bronze Rod and observe its many advantages.

You will see how freely it flows and what unusually good, clean, strong welds it helps to make, whether you use gas or arc.

Ask your supplier now for Bridgeport's "1232". This silicon alloy is one of Bridgeport's many specialized and general purpose bronze alloy rods.

Coming to the National Metal Exposition in Cleveland? You will find plenty to interest you at Bridgeport's Booth No. Y-27.

"Bridgeport"

BRIDGEPORT BRASS CO.

Established 1865

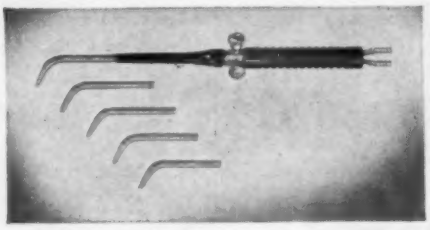
BRIDGEPORT · CONN.

New Product Developments

New Aircraft Welding Torch

★ **The Dockson Corp.**, 3839 Wabash Ave., Detroit, Mich., has announced a new Featherweight **Series "9" Aircraft Welding Torch.**

Designed with duralumin tips and fibre handle, the Series "9" torch weighs only 5 ounces. It is claimed that the fibre handle insures a cool grip at all times, while the convenient location of the spring tension valves make possible one hand adjustment during operation. This new featherweight may be used with any of the interchangeable duralumin tips from 1 to 6 inclusive.



New aircraft welding torch weighs only 5 ounces.

Complete details on this new aircraft welding torch may be obtained from the Dockson Corporation.

» «

High Tensile Aluminum Bronze Welding Rod

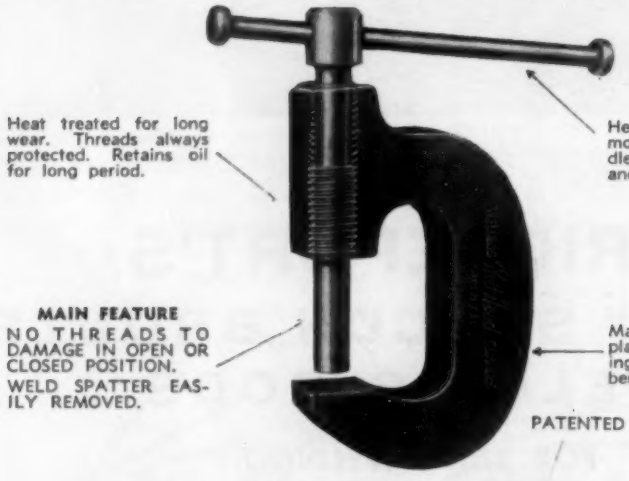
The demand for a bronze welding rod that would lend itself readily to the varied requirements of maintenance and fabrication has led to the development of **Ampco-Weld** weldrod. This is an aluminum bronze rod that maintains the high strength, 60,000 to 90,000 p.s.i., and hardness of the copper-aluminum-iron alloys produced by **Ampco Metal, Inc.**, Milwaukee, Wisconsin.

In the past, welding with ordinary non-ferrous rod usually required that the base metal, whether cast iron, steel, or non-ferrous, be preheated to a high temperature, entailing a long and tedious gas welding operation. In general, this method, which was costly in both time and material, is unnecessary with Ampco-Weld, nor is the use of Ampco-Weld limited to any one method of application. In addition the weld metal has been shown to have the high bearing qualities, wear resistance, fatigue strength, and impact strength, inherent in alloys of this composition, as compared to those of copper-zinc or copper-tin series.

For maintenance purposes, Ampco-Weld has been adopted for building up worn, heavy-duty gears which might otherwise have to be scrapped, or in repairing broken gear teeth and other metal parts. Other maintenance jobs are rebuilding worn cams, or worn forming and drawing dies, as well as in covering surfaces over which metal slides, in order to eliminate objectionable draw lines.

Ampco-Weld can be supplied in six standard grades of Ampco Metal—12, 16, 18, 20, 21, and 22. The rod may be obtained in $\frac{1}{8}$", $\frac{5}{32}$", or $\frac{1}{4}$" diameter, with light, medium, or heavy coating, according to the requirements of the job on which it is to be used. The medium coating is suitable where an all-purpose rod is desired. The light coating is recommended for use with gas welding, the medium coating for carbon arc welding, and the heavy coating for metallic arc welding.

"Red Head"
WELDING CLAMPS
Withstands All Welding and Handling Abuses


Heat treated for long wear. Threads always protected. Retains oil for long period.
Heat treated chrome molybdenum alloy handle offers great resistance to bending.
MAIN FEATURE
NO THREADS TO DAMAGE IN OPEN OR CLOSED POSITION.
WELD SPATTER EASILY REMOVED.
Made from solid steel plate, heat treated, giving great resistance to bending or twisting.
PATENTED

14 STOCK SIZES
Special Sizes and Shapes Furnished for Special Applications

INDESTRUCTIBLE CONCEALED THREADS

Red Head Welding Clamps have been especially designed for welding service. Their construction eliminates the trouble caused by weld spatter or accidental damage to threads. A clamp that will stand up under the most rigorous service over long periods of time.

A trial will convince you. Send for sizes and prices today.

CHICAGO BOILER COMPANY
1965 Clybourn Avenue Chicago, Illinois

NOW IS THE TIME TO JOIN THE
American Welding Society
33 West 39th Street
New York City

New Product Developments

Versatile Tool Aids in Welding of Bulky Parts

★ The **Util-A-Tool** introduced by **Templeton, Kenly & Co.**, 1020 S. Central Ave., Chicago, may solve some of the problems experienced by welders in welding structural shapes and on reclamation and hard-facing welding. The Util-A-Tool consists of 8 pieces of equipment used in

The Util-A-Tool readily holds a large gear in position for welding.

various combinations in conjunction with a push and pull jack. The jack consists of two lugged nuts on a forged steel screw fitted with a ratchet handle. Working the ratchet brings them together or moves them apart on the screw. The entire unit comes in a compact metal carrying case.

Three ½ in. x 40 in. chains, part of the equipment, are used to bind pipe, beams, etc., to hold them in place for welding. For longer parts, such as the large cement mill gear shown, cable can be used.

In addition to holding parts for welding, the Util-A-Tool can be used to bend pipe and structural steel or to straighten bent axles, pipe, etc. It also pulls plate center or spoked wheels, gears and pulleys and loosen frozen or stuck objects. The slip-on base provided enables the unit to be used as a standard 10-ton jack.

A bulletin P & P 40, gives details on its construction and use.

» «

The Designing of Steel Castings

★ The **Steel Founders' Society of America** has prepared a sound slide film, to explain all the known and tested principles of steel casting design. The film runs a half hour, and is entertaining as well as educational. The various principles of design are simply and clearly brought out. The highly technical subject is treated in an informal, interesting manner, making it easily understood even by those without technical education.

The new film is available for showing before local chapters of engineering societies. Sound and projection equipment can also be supplied without charge. Requests for bookings should be addressed to Steel Founders' Society of America, 920 Midland Building, Cleveland, Ohio—on the West Coast, to George Kennard, Northern California Foundrymen's Institute, 304 Rialto Building, San Francisco, Calif.

Construction

H. C. Price Co. of Bartlesville, Oklahoma, has been awarded the contracts for electric welding on the following pipe lines:

For **Natural Gas Pipe Line Co. of America**—100 Miles of 20-inch from Geneseo, Illinois to Rockford, Illinois—General Contractor Dempsey-Wilson Construction Co.

For **National Refining Co.**—57 Miles of 8-inch from Cedarvale, Kansas to Coffeyville, Kansas—General Contractor Williams Brothers Corp.

For **Magnolia Pipe Line Co.**—17 Miles of 6-inch and 8-inch near East St. Louis, Illinois—General Contractor Sheehan Pipe Line Construction Co.

Scientific Protection
FOR THE WELDER

In Welding . . . the most vital factor in the fabrication of metals for modern industry . . . SELLSTROM has developed a widely diversified line to fulfill general and exacting requirements. Many features emphasized in our products are exclusive with Sellstrom. This applies particularly to goggles, spectacles, helmets, shields, and respirators that have been developed for the Welder's comfort as well as safety.

WRITE FOR CATALOG No. 18 SHOWING COMPLETE LINE.

Sellstrom Mfg. Co.
642 N. Aberdeen St. Chicago, Ill.

The Improved "Round File" Gas Lighter

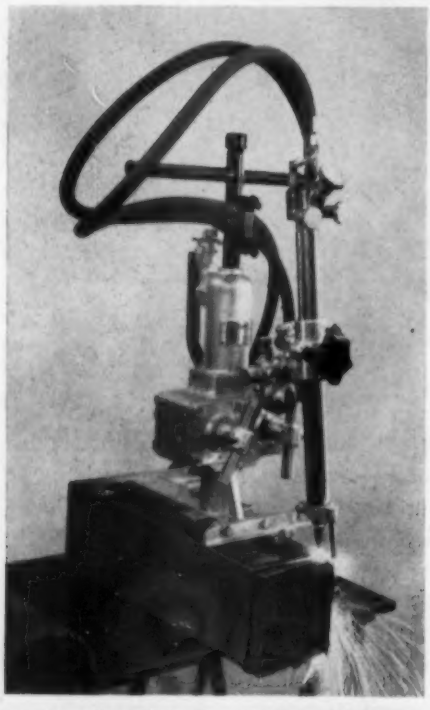
Immediate Ignition Assured

The Hood of the Improved "Round File" Gas Lighter is so designed as to form a "pocket" for the gas—an exclusive feature—which assures IMMEDIATE ignition. Get acquainted with the many other superior, exclusive features of Improved "Round File" *circulars and prices on request.*

SAFETY GAS LIGHTER CO. (Est. 1901) **LYNN, MASS.**

New Bar-Cutting Machine

★ A new oxy-acetylene bar-cutting machine designed for a number of steel mill cut-off operations has just been announced by **The Linde Air Products Co.**, New York, N. Y. This portable



The Oxweld CM-35 Bar-Cutting Machine is shown making a drop cut on a square billet, 6 by 6 by 26 inches.

machine, known as the **Oxweld CM-35 Bar-Cutting Machine**, will cut rounds or squares with a minimum of adjustment and is driven by a self-contained spring-power unit, the speed of which is hydraulically controlled.

Heretofore heavy and complicated attachments have been used on straight-line cutting machines to obtain the desired blowpipe motion when cutting rounds, in which the blowpipe must move in a vertical arc, or when cutting squares with a swinging blowpipe. The CM-35, however, is simple in operation, the correct motion for cutting either rounds or squares being transmitted positively to the blowpipe by an easily adjusted linkage mechanism. Hydraulic control provides an ideally smooth blowpipe travel with an almost infinite variation of cutting speeds between 1 and 75 in. per min.

This feature of a self-contained power unit offers the additional advantage of increased portability. The cutting machine can be used indoors or out, wherever oxygen and acetylene are available, and can be moved to a new work place at a moment's notice, since neither electric power nor guide track is necessary for its operation. The CM-35 with standard equipment has a cutting range of from 2 in. to 10 in. This range can be changed, however, to 8 to 15 in. by means of special linkage arms.

» «

Colmonoy Furnace Weld Process

★ This new hard-facing method consists of applying a layer of **Colmonoy No. 6** alloy to a steel base by a furnace bonding process in which no additional bonding material is required. The temperature required is not high enough to completely fuse the hard-facing overlay, thus maintaining its dimension and shape to which it was pre-cast.

This method of bonding the hard-facing alloy to the steel base claims advantages since the bonding material has a much higher melting point and is essentially the same as the main body of the hard facing. The greatest advantage claimed of the process is its adaptability to high production parts and its adaptability to intricate parts or where the overlay is inaccessible for torch application.

Complete information regarding the use of this process, on which a patent is pending, may be obtained from the **Wall-Colmonoy Corp.**, 1067 West Grand Blvd., Detroit, Mich.

Are Your Electrodes Really Dried?

Are they thoroughly dried? Inside as well as outside? Proof against exposure to water? Proof against blowholes in weld metal caused by entrapped moisture? Another thing entrapped moisture can do is to expand and blow chips of the coating away beyond the arc.

Are they properly dried? This means dried so that the coating adheres strongly and solidly to the core, leaving no voids to facilitate flaking off when the electrode gets rough treatment.

Several installations of Steiner ovens verify the ability of the Steiner engineering staff to design and build drying equipment to the most exacting requirements of the coated electrode industry. Users of Steiner Ovens have no moisture troubles.

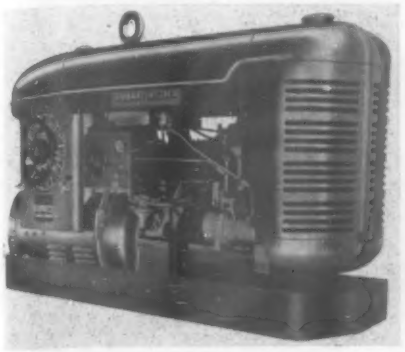
Although they are extremely flexible, all Steiner ovens are custom built. **An inquiry will bring you an engineering analysis of the drying problem and its solution.**

STEINER OVEN DIVISION

STEINER-IVES COMPANY, 16 Avenue L, Newark, N. J.

Gas Engine Drive Arc Welder

★1000 combinations of voltage and welding current are said to be possible from the 200-amp. "Streamliner" Junior gasoline engine driven arc welder developed by **Hobart Brothers Co.**, Troy, Ohio. Powered by a 26-hp. Hercules engine, this welder is particularly suitable for job welding shops, blacksmiths, repair shops, contractors, garages and miscellaneous metal working shops.



The "Streamliner" Junior is power by 26-hp. engine.

Oversized design, ample copper and steel, and sensible operating speeds are all said to contribute materially to lower welding costs. Known as the **Model GR-202-S**, this unit embodies a modern battery ignition system, electric self starter, electric fuel pump, self-starting pushbutton and ignition lock. Also included as standard equipment are remote control of welding current, polarity switch, convenient power outlet plug, variable speed governor, solid-core radiator and built-in fuel tank. All are mounted on a rigid steel base, with a sturdy lifting eye for handling with crane or hoist.

GREYHOUND

CUSTOM BUILT

TRANSFORMERS WOUND WITH DOUBLE WOVEN SPUN GLASS MAGNET WIRE

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CONTINUOUS WELDING

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5-YEAR GUARANTEE

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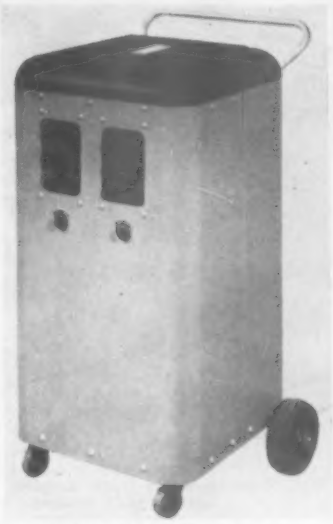
5 MODELS RANGING FROM 100 TO 300 AMPERES



A. C. ARC WELDERS

AUTOMATIC VOLTAGE CONTROL

•

ELECTRICALLY BALANCED

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ENGINEERED FOR A LIFETIME OF CONTINUOUS SERVICE

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PRICED $55.00 TO $275.00 COMPLETE WITH ALL ACCESSORIES

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INDUSTRIAL MODEL S.P. 300
28 Continuous Welding Ranges 15 to 300 Amperes

JOBBERS' INQUIRIES SOLICITED, EXCLUSIVE TERRITORIES AVAILABLE.

Manufactured By

GREYHOUND ELECTRIC MFG. CO., INC. 31 GRAND STREET BROOKLYN, N. Y.

News of the Industry

Civil Service Examinations — Junior Engineer — The United States Civil Service Commission has announced an open competitive examination to secure junior engineers for Government service. The examinations cover all branches of engineering except aeronautical, naval architecture and marine engineering. The salary of $2,000 a year is subject to a retirement deduction of 3½ percent.

Applications must be in the Commission's Washington office not later than October 24 if received from States east of Colorado, and October 28, 1940, if received from Colorado and States westward.

Applicants must have completed a 4-year engineering course at a recognized college. They will be rated on a written examination consisting of general and professional questions. The maximum age limit is thirty-five years, unless applicants are granted veteran preference.

Aircraft Procurement Inspectors—An examination has been announced, and is now open until further notice, for procurement inspectors in the Material Division, Air Corps, War Department, at Wright Field, Dayton, Ohio. The Civil Service Commission states that there is an urgent need to fill these positions. Qualified persons are urged to apply at once.

There are three grades of positions as follows: The full grade, paying $2,300 a year; senior grade, $2,600 a year; and the assistant grade, $2,000 a year. The examination includes six branches of inspection work—aircraft, engines, instruments, parachutes, aircraft propellers, and tools and gauges.

Applicants will not be given a written test. They will be rated upon their education and experience as shown in their applications, subject to verification by the Commission. Senior inspector appli-

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for welding of Aluminum

TYPE G-2, for gas welding

Ready fluxed, with the correct proportions of flux on each rod, assuring:

Ease of Control

Free-Flowing Characteristics

Increased Welding Speeds

TYPE E-1, for arc welding

Assure dense, ductile and strong welds.

Send for descriptive circular.

Complete line of welding lenses—filter, spatter-resisting, and clear cover glass, etc. *Details on request.*

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"WILL IT STAND UP?"
"IS IT SAFE?"
OVER 4000 YEARS* OF WELDING EXPERIENCE ANSWERS YES!
*The combined experience of more than 1200 G-R users.
SEVEN MODELS, from 125 to 1250 amperes. Also units to 2000 amperes for automatic head and UNIONMELT welding. WRITE for free literature.
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cants must have had at least seven years, inspectors at least six years, and assistants at least four years, of (a) mechanical experience (which may include apprenticeship), in one of the major skilled trades in the optional branch chosen, with an aircraft manufacturing plant; or (b) in aircraft procurement inspection; or any time-equivalent combination of the two. Applicants may substitute college courses in engineering for the experience.

Persons experienced and interested in this type of work should apply for details and the proper application forms to the Secretary, Board of United States Civil Service Examiners at any first- or second-class post office; to the United States Civil Service Commission, Washington, D. C., or to any of the Commission's district offices.

Personals

Edward Walters, formerly of the Chicago office of the **Harnischfeger Corp.,** Milwaukee, has been transferred to the position of assistant sales manager of the Welder and Electrode Div. of the Harnischfeger Corp. in Milwaukee.

» «

Basil Osmin, Welding Supervisor for the **United Engineers and Constructors, Inc.,** has revently been transferred from the Burlington, New Jersey Field Office to another Power Plant Project near Newark; the new address being P. O. Box No. 239, Newark, New Jersey. This Project is known as the "Marion Generating Station" of the Public Service Electric & Gas Company of New Jersey.

» «

K. R. Setterblade announces that the **Weld-O-Lectric Sales Co.,** 5651 W. Ohio St., Chicago, has been established to assist any manufacturer using welding as a part of their production procedure, specializing in those applications where alloys and non-ferrous metals are used. Their services, however, are not limited to just alloys and non-ferrous metals, but cover the entire welding field with special emphasis on alloys.

In addition, the Weld-O-Lectric Sales Co. supply materials used in the welding of the various alloys, non-ferrous metals and carbon steel along with the usual welding accessories and equipment used in connection with the different welding processes.

» «

Milton P. Higgins, resident manager of the Norton electric furnace plant at Chippawa, Ontario, for the past two years, has been transferred to the Worcester headquarters as Assistant Manager of Abrasive Production and Research. Mr. Higgins has been with the **Norton Co.** for about 12 years. Previous to the Chippawa post, he was manager of sales research at Worcester and in special sales work in the Chicago territory. He is a director of Norton Co. and also of their Behr-Manning division.

» «

The **Harnischfeger Corp.** of Milwaukee has appointed as agents for its line of welders and electrodes the **Faeth Co.,** 1127-1131 W. 8th St., Kansas City, Mo. The Faeth Co. will operate in the Kansas City territory under the supervision of **Mr. C. Powell.**

Whiting Corporation Absorbs Quickwork Company—The Whiting Corp., Harvey, Ill., announces the acquisition of the Quickwork Co., formerly of St. Marys, Ohio and Chicago, Ill., manufacturers of rotary shears, stamping trimmers and forming machines, power hammers, throatless shears and flangers.

The entire Quickwork line will be manufactured by the 56-year old Whiting organization in their 20-acre plant at Harvey. **Stevens H. Hammond,** Vice-President of the Whiting Corp., will be in charge of all Quickwork operations. **Paul V. Hyland,** formerly of the industrial division of Whiting, has been appointed Quickwork Sales Manager. **B. W. Packer,** formerly with the Quickwork Co., joins the new organization as chief engineer. S. M. Steinko will be in charge of advertising activities.

Paul V. Hyland

Mr. Hammond, in commenting on the acquisition of the Quickwork Company by Whiting, says, "The products of the 29-year old Quickwork Company mesh so closely into the present National Defense Program that Whiting is immediately putting back of their manufacture all the facilities and experience of the Whiting Corporation so that there need be no delay in the delivery of these essential metal-working machines."

» «

National to Produce and Distribute Rego Equipment

★ An arrangement has been entered into between the National Cylinder Gas Company and The Bastian-Blessing Company which becomes effective at once. National will use the facilities of The Bastian-Blessing Company and engage in the production of a complete line of gas welding and cutting equipment under the Rego trade mark. The arrangement perpetuates the activities of the fine Rego Distributor organization, making Rego available not only through such Distributors but also through National district sales offices in all principal cities, according to Ellsworth L. Mills, Vice President of The Bastian-Blessing Company of Chicago.

"This is a progressive and timely National Cylinder Gas Company step," said Mills, "whereby National's advancing organization, with whom Compressed Industrial Gases, Inc. recently merged, intends to use the facilities of The Bastian-Blessing Company and engage in the production of an even more complete line of welding and cutting equipment under the Rego trade name.

"Existing Rego Distributors will find advantages in the association. The move, from our standpoint, widens distribution tremendously, making Rego available in complete stocks of equipment, repair and replacement parts through National district sales offices in all principal cities and through a family of jobbers in all key distributing centers.

"The welding and cutting industry is at the threshold of greater expansion. Shipbuilding, aircraft, automotive, arsenal production techniques are turning to it more enthusiastically to gain the advantages and economies which the welding and cutting arts now make possible.

"Rego has been the symbol of many advances in the control and use of high pressure gases, starting its pioneering history in 1908. Our engineering staff has recently created new developments of great service in the accelerated production, maintenance and repair demand of these times. Naturally, it is our desire to make the more complete Rego line more instantaneously available everywhere.

"So we are happy to announce this association with the National Cylinder Gas Company, knowing that distribution will be greatly widened and our facilities consequently enlarged to the complete service of gas welding and cutting needs throughout the country," concluded Mills.

» «

T. T. Watson, who has been Development and Service Metallurgist of **Lukens Steel Co.** since 1934, has been appointed Research Metallurgist in charge of all plant research. Mr. Watson was graduated in 1923 from the Royal Technical College, Glasgow, Scotland with the degree of Associate of the Royal Technical College. He joined David Colville & Sons, largest iron and steel manufacturer in Scotland, as Assistant Metallurgist immediately after graduation, and served in that capacity until 1925, when he became Metallurgist for the Clyde Alloy Steel Co.

From 1927 to 1930, Mr. Watson was Assistant Metallurgist at Dorman Long and Co., England. Since 1930, he has been in the United States, as a Consulting Metallurgist first, and for the last nine years successively as member of the Metallurgical Department, Development and Service Metallurgist, and now Research Metallurgist for Lukens Steel Company.

» «

The **Chicago Hardware Foundry Co.** of North Chicago, Ill., manufacturers of cast iron welding rods, announces the advancement of **R. J. Franklin** to Manager of the Weld Rod Department. Mr. Franklin recently developed machineable cast iron electrodes for this company and has had a varied experience in development and sales work with the Wilson Welder & Metals Co. and the Ludlum Steel Co.

INCREASE PRODUCTION . . .

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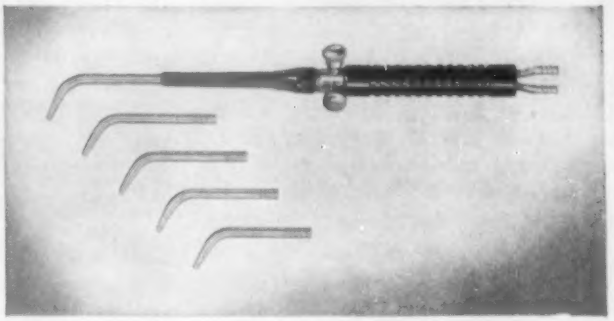
Featherweight

SERIES "9"

AIRCRAFT WELDING TORCH



A Trial will prove the merits of this new and unusual torch.

See Your Dockson Distributor or write

WEIGHS ONLY 5 OUNCES

Fibre handle insures cool grip at all times. Spring tension valves located at finger tips for instant one hand adjustment. Duralumin tip tube with full range of tips from 1 to 6 inclusive.

DOCKSON Corporation

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WELDING AND CUTTING TORCHES
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SEE Ransome

Revolving Welding Positioners

at

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National Metal Exposition
Cleveland

Hand and Power operated models will be exhibited in operation.

Write for Bulletin

W-1-40

INDUSTRIAL DIVISION

RANSOME CONCRETE MACHINERY CO., DUNELLEN, N. J.

H. T. Habermann joins **Titan Metal Manufacturing Co.** Mr. Habermann, who was formerly Sales Manager of the Harper-Wyman Co., is now associated with M. A. Purvin in the Chicago Office in a sales and engineering capacity. While Mr. Habermann will be available to offer engineering assistance on the entire Titan line of brass forging, die castings and screw machine parts, it is announced that he will specialize on welding rod problems.

» «

Carnegie - Illinois Steel Corp. announced the appointment of **J. F. Brown** as construction engineer for the Chicago district and **A. J. Hulse** as chief engineer of South works, succeeding Mr. Brown.

Mr. Brown was first employed at South works in 1904 in the civil engineering department. Shortly afterward he became assistant chief civil engineer and in 1906 was appointed chief civil engineer, the position he held until 1930 when he was made construction engineer. Two years later he became acting chief civil engineer and in 1936 was given the post of chief engineer, the position he held until the present time.

Mr. Hulse entered the service of the corporation in 1936 as assistant chief engineer at South works. He was transferred to the Pittsburgh offices as staff engineer three years later and remained there in that capacity until this time. Before coming to the corporation he served as chief draftsman and assistant chief engineer for Republic Steel Company, chief engineer for H. A. Brassert and Company, assistant chief engineer for Keystone Steel & Wire Company, and proposal engineer for the United Engineering and Foundry Company.

Current Reviews

Spot Welding Electrode

The **Eisler Engineering Co.**, 740 So. 13th St., Newark, N. J., announce the release of a new **Welder Bulletin No. 41-WB,** showing the latest model Eisler spot welders and their adaptability to welding jobs.

» «

New Murex Bulletin

★ **The Metal & Thermit Corp.**, 120 Broadway, New York, have just published a 23-page pamphlet, giving full data on physical properties, chemical analyses, qualifications and approvals of Murex mild steel electrodes, as well as similar but more condensed information on Murex alloy steel rods.

"Welding Briefs," a news bulletin type of house organ, is now being published regularly. "Welding Briefs" reviews interesting welding applications and contains in each issue some useful data on welding costs and welding procedures or other technical information. The publication is free and names are placed on the mailing list on request.

» «

Two Hobart Bulletins

★ Two new bulletins by **Hobart Brothers Co.**, Troy, Ohio, are now available for distribution to anyone interested in arc welding. An eight page rotogravure sheet illustrates various applications of welding and contains suggestions for those interested in **"Building Their Own"** Arc Welder. Ask for Bulletin number DM-582. Another interesting piece is a 40 page booklet in a handy vest-pocket size titled **"A Trip Through The Most Modern Arc Welder Factory In The World".** Covers facts about arc welding machines and their construction. Ask for Bulletin DM-502.

» «

Flame Cutting Charts

★ The **Modern Engineering Co.** announce the publication of a new wall chart on flame cutting. Printed on cardboard, the **Flame Cutting Data Chart** gives comprehensive information on the diameter of tip to be used in cutting various thicknesses of steel, oxygen pressure and cutting speed as well as gas consumption per foot and per hour. The information given is for both hand and machine cutting of steel up to 20 in. thick.

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BOOTH No. D-29
NATIONAL METAL
EXPOSITION
We manufacture a complete line of ELECTRIC SPOT WELDERS from ¼ to 500 KVA for welding brass, aluminum, bronze, stainless steel, tantalum, nichrome, tin plate, copper, nickel, silver, gold, etc.
We can supply a welder for all special needs.
Butt welders to weld from .010" to ½" diameter metal.
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Banish Welding Fumes!
Here's a Practical Welding Fume Collector* that Removes Noxious Gases, Heat and Smoke at the Source
*Pat. Re-21,277
● MORE than 500 in operation. Used for gas or electric welding operations, especially where alloy steels are used.
● See it in operation at the National Metal Exposition in Cleveland, Booth F-7-A.
RUEMELIN MFG. CO.
3880 N. Palmer St. Milwaukee, Wis.
RUEMELIN FUME COLLECTOR
A 2964-½

On the reverse side of this chart is considerable information on metals that may be welded. Included in the information is the melting point, weight per cu. ft., Brinell hardness, chemical symbols and other pertinent data.

Those readers of The Welding Engineer desiring a copy of the Flame Cutting Data Chart may obtain it by writing to **Modern Engineering Co.**, 3407 Pine Blvd., St. Louis, Mo.

» «

How to Assemble a Welding or Cutting Unit

★ **Setting Up a Victor Welding Unit** is the title of a new worthwhile booklet for the beginner which has recently been issued by the Victor Equipment Co.

To give aid to the thousands of beginners who are now attempting to acquaint themselves with the equipments used and the processes employed in welding and cutting this small booklet confining itself entirely to an understandable description of "How To Assemble The Welding And Cutting Unit." Large, full-page illustrations (5 x 7 in.) clearly visualize each step.

Three pages of "Simple Safety Precautions" and three pages of "Tip Selection Charts" are included. This booklet will be furnished free of charge to any vocational school or college and to any student or beginner who will write for it.

The booklet may be obtained by those qualified from the **Victor Equipment Co.**, 844-50 Folsom St., San Francisco, Cal., or through any authorized Victor Distributor.

Recent Patents

Multiple Spot Welder

2,213,709. **Joseph R. Lex**, Detroit, Mich., assigned to General Motors Corp., Detroit, Mich. Filed Jan. 21, 1939. Issued Sept. 3, 1940. The modern all-steel body for automobiles is made up of a plurality of large stampings. Many parts have to be welded in the construction of the body. These include reinforcing channels, electric wiring support clips and rocker panels. It is desirable to carry out the welding while the work moves on a conveyor. According to this patent a welding system is used which operates on the principle of a large number of welding electrodes simultaneously gripping the work while the work is moving and then applying the current successively through the electrodes. The welding is accomplished without noise or pounding of the electrodes. The machine has a moving conveyor provided with an electrode fixture moving always in one direction with the conveyor for carrying separate work pieces. A gang welding apparatus provided with a plurality of electrodes moves with the work and the electrode fixture and welds the work pieces together while the pieces are moving. A distributor is used to supply electrical energy successively to the various electrodes.

» «

Torch Control Valve

2,213,748. **Ludwig W. Stettner**, Piedmont, Calif., assigned to Victor Equipment Co., San Francisco, Calif. Filed Jan. 10, 1939. Issued Sept. 3, 1940. An improved hand valve arrangement for welding torches is described in this patent. Simply operated devices for locking the valves which control the flow of gases are disclosed. The locks hold both valves in open position, or in closed position, or one closed and one slightly open sufficient to operate a pilot flame. The torch has a pair of needle valves each fitted with a lever handle extending along the torch and pivoted to the torch. The levers may be operated by the torch holding hand, and each lever is provided with a spring latch so formed as to firmly lock its lever in open or closed position. The levers may be released from locked position by means of a thumb release trigger. A feature of great importance, according to the inventor, is that both valves are not only locked in open position so that the levers need not be held down by hand,

THREE *New* METRO PRODUCTS

METRO new-type OUTSIDE-riveted Welding Helmets. Possess pressed steel lens-holder, and spring steel lens-retainer.

Send for prices and full particulars

Distributors wanted for Metro Products: several territories available.

(Patents Pending on All Models)

New METRO Bakelite 50 mm Welding Goggles provide:
MAXIMUM VENTILATION
No Lens Fogging.

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HIGHEST QUALITY

FLAT FILE - ROUND FILE - AUTOMATIC

REGULAR SIZE

GAS LIGHTERS AND RENEWAL FLINTS

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but are also automatically locked in closed position, or with a small pilot light burning, as this overcomes the otherwise great danger of a long dangerous flame shooting out if the torch were inadvertently dropped, or if someone accidentally dropped something on the handles while the torch was lying on the bench or floor with pilot burning.

» «

Welding Veneered Plate

2,214,002. **James E. Trainer,** Fairlawn, and **James C. Hodge,** Akron, Ohio, assigned to The Babcock & Wilcox Co., Newark, N. J. Filed Mar. 15, 1936. Issued Sept. 10, 1940. This invention has as a feature a type of veneered plate which, when incorporated in pressure vessels, presents the advantage of having firstly, adequate radial drainage of heat; and, secondly, a resistance weld bonding substantially co-extensive with the superimposed areas of the base metal plate and the veneering sheet without contamination of the veneering by any constituents of the base metal plate. A method of stitch welding is described in which a carbon barrier sheet intermediate the other two sheets has the function not only of acting as a carbon barrier but of providing a bonding sheet which may present a lowered resistance to bonding with the base metal plate and the alloy veneering as compared with that resistance to bonding which may exist between certain alloys and the base metal if attempts are made to directly unite these sheets. The process includes associating a thin liner sheet of high chromium steel over a thick base plate of steel with a thin nickel sheet between the base plate and the liner, and then subjecting the composite structure to a continuously high pressure at spots at which electrical welding takes place.

» «

Fushion Apparatus

2,214,031. **Harry E. Rockefeller,** New York, N. Y., assigned to Union Carbide and Carbon Corp., of New York. Filed Sept. 30, 1938. Issued Sept. 10, 1940. Metal members are joined by a method which involves inserting between the ends to be joined a metal having a fusion point lower than that of the metal members. Heat is then applied indirectly to the inserted metal by conduction through one or both of the metal members in such a manner and with sufficient intensity to melt or fuse the inserted metal and upon solidification unite the metal members together. For steel and iron welding a suitable insert metal may be an alloy of copper, such as bronze. A heat of at least 1620 degrees Fahrenheit in the steel adjacent the bronze is sufficient to fuse the bronze alloy. A suitable flux of borax and boric acid may be employed to facilitate the fusion of the members. Circular shaped heating units are used for the fusion operation.

» «

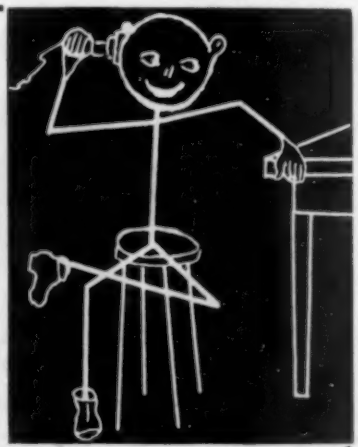
Spot Welding Electrode

2,212,154. **Meril L. Eckman,** Cleveland, Ohio, assigned to The American Coach & Body Co., Cleveland, Ohio. Filed Oct. 4, 1938. Issued Aug. 20, 1940. An object of this invention is to make a portable device which enables an operator to press the electrodes with considerable force against the work, and which will assure the exertion of sufficient pressure to result in a satisfactory weld. The invention includes a circuit controller that requires the exertion of a predetermined pressure against the work before current is allowed to flow through the electrodes. The welder has electrodes having terminals pivotally mounted for movement relatively toward each other. The pivot may be shifted in order to vary the degree of force that is to be exerted by the electrodes against the work. The circuit controller is carried by one of the electrodes and is operable upon movement of the welder arms to a predetermined position. A suitable spring of the proper size for the work to be welded assures the exertion of the correct pressure against the work before the current flows.

» «

Rail Welder

2,212,393. **William Dalton,** Schenectady, N. Y., assigned to General Electric Co., of New York. Filed Oct. 29, 1938. Issued



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"ANTI-BORAX" FLUXES

"A FLUX FOR EVERY METAL"

Cast-Iron Flux No. 1; Brazing Flux No. 2; "Braz-Cast" Flux No. 4 (for bronze welding cast-iron); Aluminum Fluxes Nos. 5 and 8; Stainless Steel Flux No. 9; Silver Solder Flux No. 10; Tinning Flux No. 11.

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MANGANAL

Reg. U. S. Pat. Office. U. S. Patents 1,876,738—1,947,167—2,021,945

11 to 13½% Manganese Nickel Steel

WELDING ELECTRODES
BARE and TITE-KOTE
For D. C. For A. C. & D. C.

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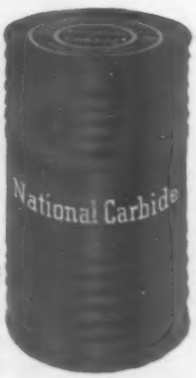

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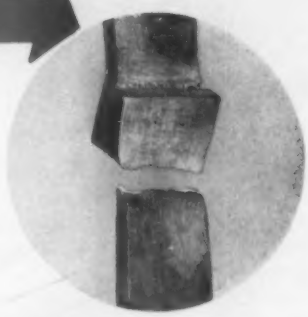
Sil-Fos and Easy-Flo brazed joints are stronger than the metals joined. Under breaking tests the metals joined give way—not the joints.



DUCTILITY

Bend, twist, hammer and pound Sil-Fos or Easy-Flo joints—the silver in them makes ductile joints that are practically indestructible.

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Turn on pressure — the metal will let go without a leak or break in the joint. Free-flowing Sil-Fos and Easy-Flo penetrate to every crevice—make leak-tight joints.

LOW COST

Thin films of Sil-Fos or Easy-Flo make the best joints. Fast application, less labor, gas and finishing expense contribute further to low costs.

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DISTRICT OFFICES: Milwaukee - Minneapolis

Aug. 20, 1940. When articles of irregular cross section such as rails are butt welded it is necessary to tilt the articles with respect to each other so that the welded articles will be straight and not bent after the welding operation. The invention provides for such tilting. Pivotal support is provided for at least one of the work supporting members of the machine. The pivotally supported member is capable of being moved relative to the other work supporting member.

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Blowpipe

2,213,043. **Wilgot J. Jacobsson,** Scotch Plains, and **Samuel R. Oldham,** Elizabeth, N. J., assigned to Oxweld Acetylene Co., of West Virginia. Filed Jan. 21, 1937. Issued August 27, 1940. This patent describes a blowpipe which is adapted to use either low or medium pressure fuel gas efficiently without danger of flashbacks. The invention is also suitable for use as an attachment for existing blowpipes, especially for converting a conventional welding blowpipe into a cutting blowpipe. This permits a minimum expense for equipment for doing both cutting and welding work. The patent points out that blowpipes may be constructed so that they will not flashback when used with fuel gas at one pressure, but if the pressure of the fuel gas is increased or decreased to any great extent, the resistance to flashback will be materially altered. This difficulty has made it necessary heretofore either to change blowpipes or at least to change the mixers or other parts of the blowpipe if the acetylene pressure was changed. A study of flashback discloses that resistance to this phenomenon may be greatly improved by greatly increasing the length of the passage between the point of mixing of the fuel gas and combustion-supporting gas and the nozzle orifice, thereby creating an increased backfire force to drive the component gases rearwardly back into their respective lines. Backflash is also minimized by providing abrupt changes or even reversals in the direction of flow of the gas mixture between the mixing point and the nozzle orifice, so as to interrupt any explosive waves that may occur. Other improving factors are more accurate alignment of the injector to improve gas distribution: provision of a gradually-tapering injector head; and provision of large acetylene and oxygen chambers around the injector with comparatively restricted feeding or gas flow to and from such chambers, so as to improve the distribution of acetylene and also produce an effective cushion in each gas line. The invention describes a separate cutting attachment for use with a welding blowpipe without changing mixers or other parts. The inventor avails himself of various features to overcome flashback.

Electrode Tongs

2,213,306. **Leon Del Bene,** Ridgefield, N. J. Filed June 13, 1939. Issued Sept. 3, 1940. It is the purpose of this invention to provide a gripping tongs for holding welding electrodes firmly without wobbling and without arcing. The electrodes may be selectively gripped in either vertical or horizontal positions, and then, if desired, bent in any desired angular deviation, while at the same time the space between the jaws is protected against entrance of clogging spatters of fused metals. The tongs is made up of a lower jaw member having a bent up L shaped end. The electrode may be inserted through a hole in the bent end portion or through a hole at right angles, for vertical or horizontal placement. A second jaw member is pivoted on the first member. The second jaw has a roughened face at the end for gripping the electrode which has been inserted through the hole in the first jaw member. After the electrode has been inserted and is held by the jaw elements, the electrode may be bent to any desired angle for welding operations. The bent portion of the lower jaw serves additionally as a shield to fend off splatterings of melted metal, and consequently guards the interior faces of the jaw members against accumulations of molten metal.

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